Compressed Air Magazine

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JANUARY, 1928

CIRCULATION THIS ISSUE
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CHRISTCHURCH, NEW ZEALAND, HAS A NOVEL SWEEPER THAT CLEANS THE BED OF THE RIVER AVON WITH JETS OF AIR AND WATER

(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 26)

Portability

Repair jobs do not respect convenience. On one side of the plant there is a steam leak that must be stopped quickly by oxwelding. Or, a machine breaks on the other side of the plant. Again a hurry call for the welder. Time after time oxwelding equipment must be transported with speed.

Then the convenience of moving a cylinder of Prest-O-Lite dissolved acetylene becomes apparent. The WK cylinder contains about 270 cubic feet of gas and weighs much less than even the smallest welding type generator; the WC size (100 cu. ft. capacity) offers a still greater factor of portability. That is why cylinders are always used where portability is essential.

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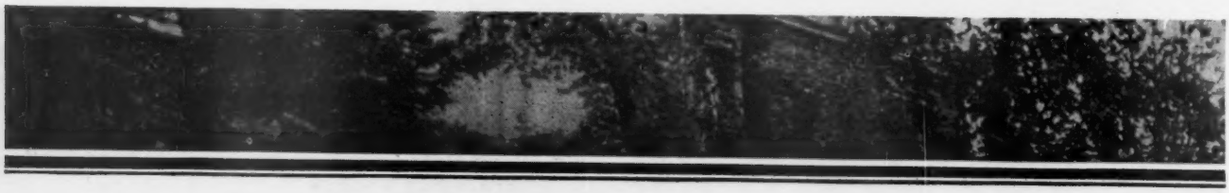
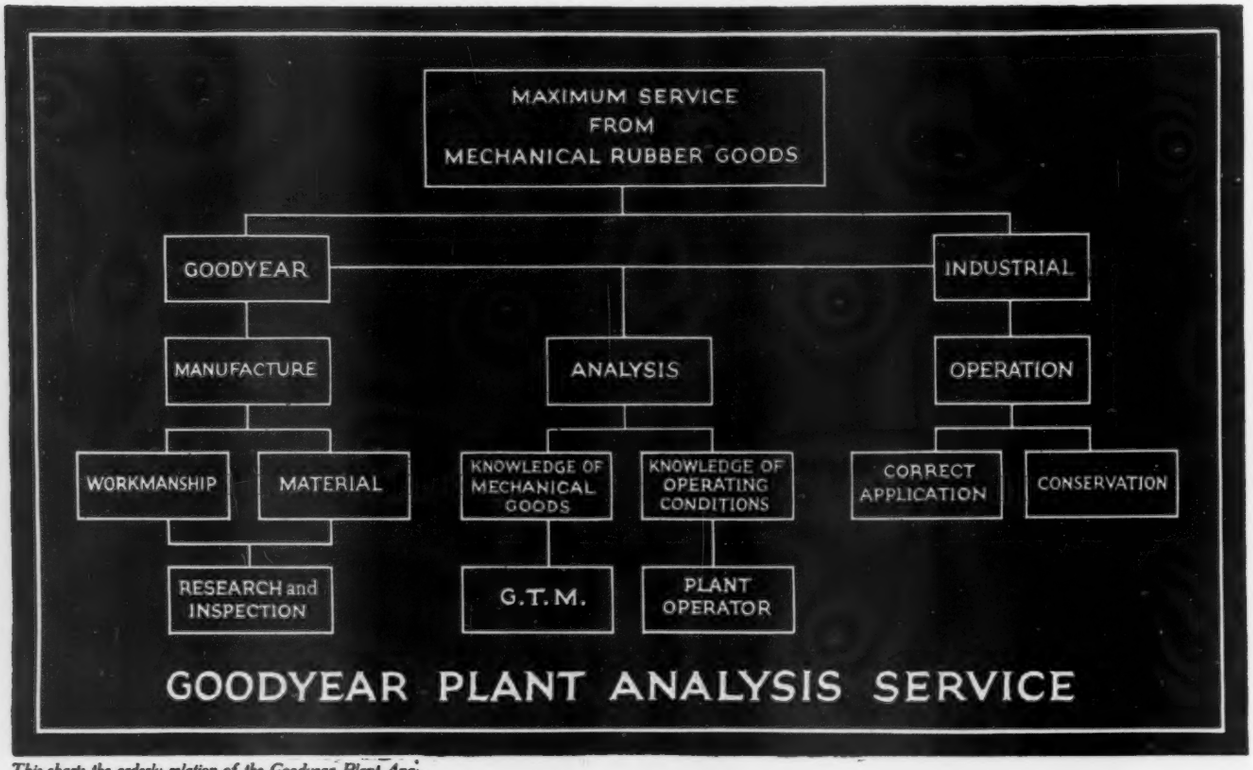


Can You Guess the Name



This charts the orderly relation of the Goodyear Plant Analysis Plan for maximum service from mechanical rubber goods

The Right Hose for Your Service

Nearly every use to which hose is put in modern industry is a use that demands a particular kind of hose, with qualities all its own.

As you very well know, quite different requirements are exacted from the hose that carries acid, for example, and the hose that carries compressed air. High pressures steadily maintained, and high pressures of pulsating character, call for different body construction in the hose. Washout hose in the paper industry must have a different tube from the tube that is wholly satisfactory for air hose. External punishment, oil in the line, the necessity for extreme flexibility—these are special requirements that must be met by special design.

The utility of a hose, therefore, depends primarily on its maker's knowledge of the working conditions which it is called on to satisfy, and the care with which you use it. The manufacturer of Goodyear Hose is concerned with both these factors, of correct construction for the duty required, and of proper use of the finished product.

The Goodyear Plant Analysis method is the means by which Goodyear helps users of hose to determine exactly what hose construction will serve them most efficiently and economically. As in the case of belting and other mechanical rubber goods, the application of this analysis plan is entrusted to the G. T. M.—Goodyear Technical Man.

The experience of Goodyear in years of careful development of Plant Analysis methods convinces us that proper analysis is exactly as important and valuable in the case of hose as in that of belts. "Just hose" is never so good nor so economical as the "right hose for the job."

The G. T. M. is an expert on hose. He is familiar with the hose requirements of many industries. In co-operation with your plant officials, he will be glad to analyze your hose problems, and help you work out a system of conservation to prolong the life of your hose.

You may depend on Goodyear Hose thus specified to your service, to give you every advantage of efficient and economical operation over a long life. For detailed information about the G. T. M., the Plant Analysis method, and the specialized hose that Goodyear makes for every line of industry, write to Goodyear, Akron, Ohio, or Los Angeles, California.

Goodyear Means Good Wear

GOODYEAR

A Barrier to Oil Engine and Compressor Costs hard To Get By

When Father Time gets around with bills for compressor and oil engine maintenance and replacement, it is too late then to regret that air filters were not installed when the equipment was in its prime.

But it's not to late too make a New Year's resolution that will considerably delay the venerable old Gentleman's next visit, no matter how far in the future this may be scheduled.

The first step toward finding out just what air filters can do for you in prolonging the life of your equipment is to send for Bulletin C describing compressor and oil engine filters in detail, together with performance reports covering actual savings accomplished.

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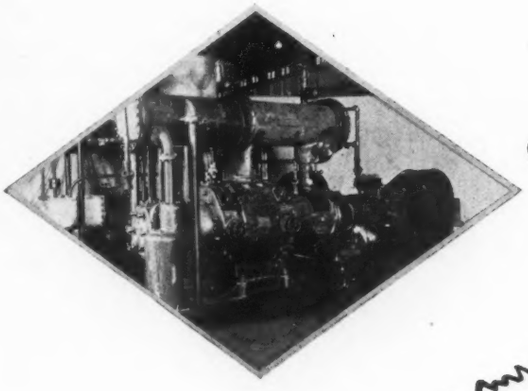
For Compressors

In the Manufacture of Helium and Other Gases



One of Many Recommendations

Borne Scrymser Company,
17 Battery Place,
New York City, N.Y.

Attention: Mr. Philip C. Mcon,
Treasurer

Gentlemen:-

In reply to your letter of March 16, 1927, I regret very much that at the present time I cannot place an order with you for an additional quantity of your DIAMOND "N" AEROIL.

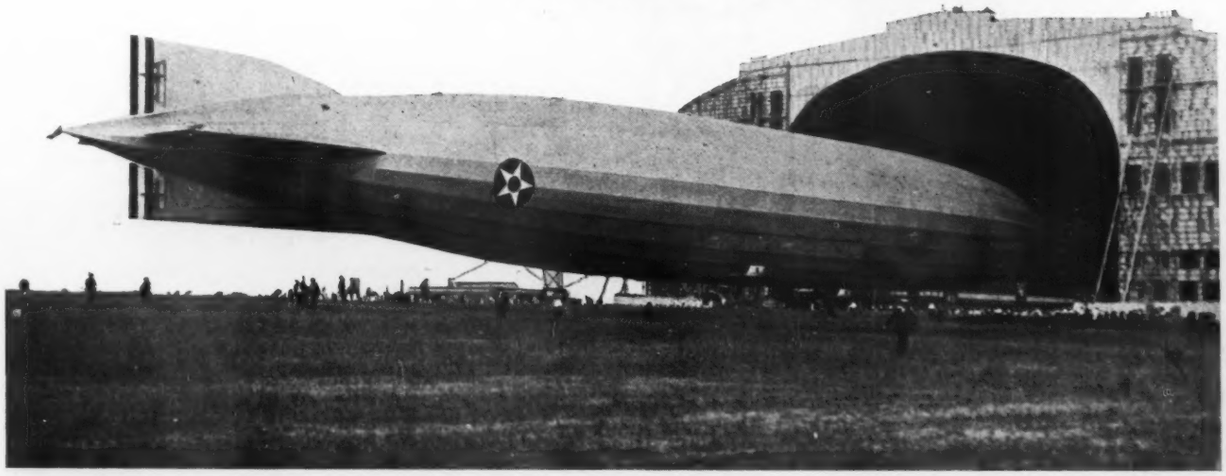
It is not believed that we will need any of this oil before the latter part of September, but you may rest assured that whenever we will need any of the oil, that order will be promptly placed.

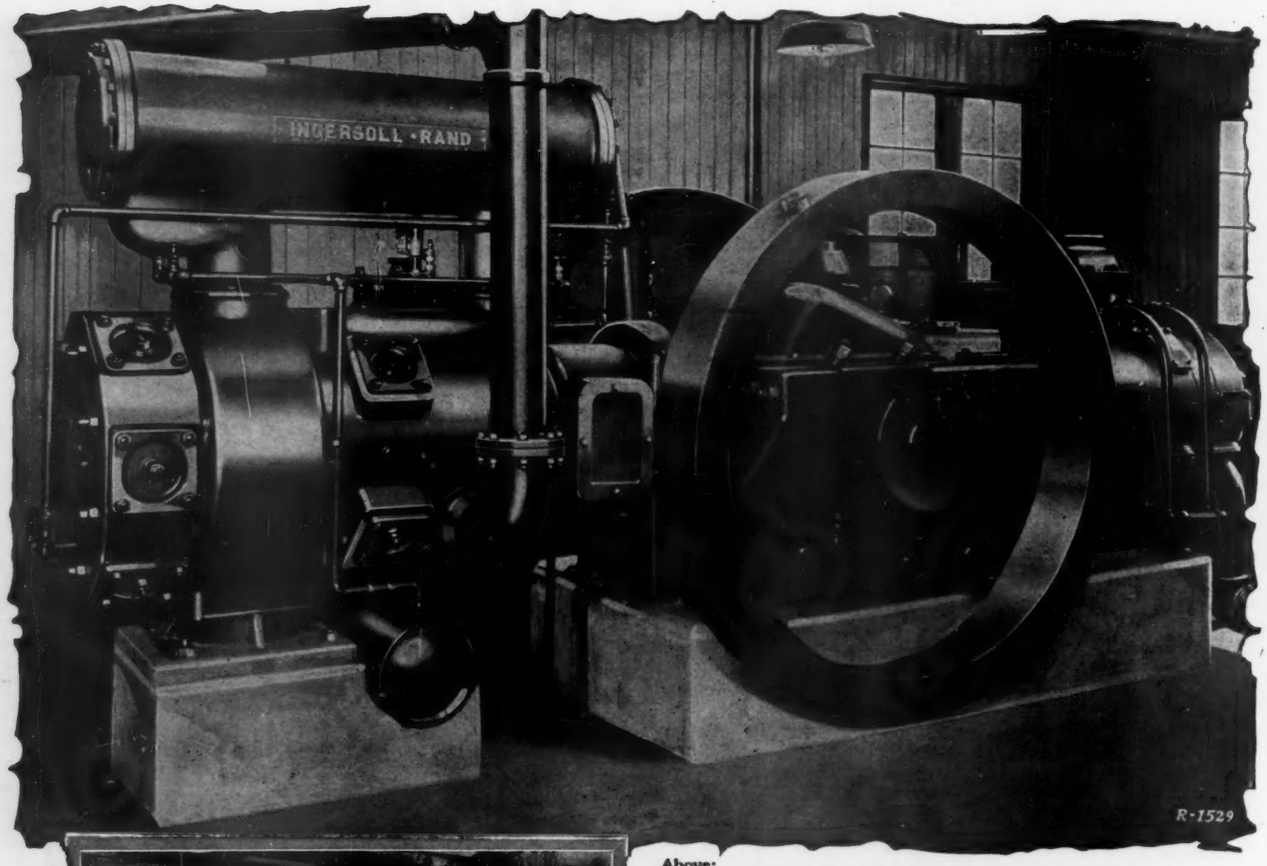
The oil has been found exceptionally satisfactory for our purposes.

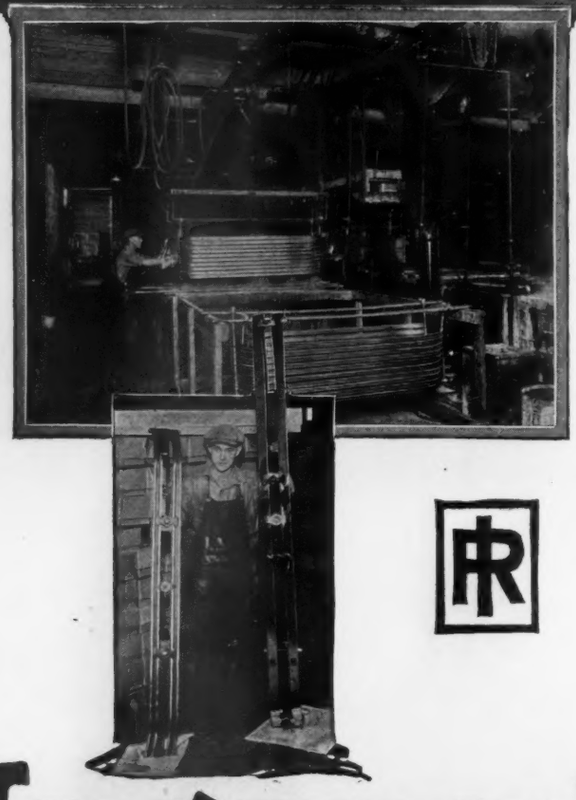
Very truly yours,

BORNE SCRYMSER COMPANY

17 BATTERY PLACE, NEW YORK







Above:
A 600-cubic-foot POC Oil Engine Compressor in the plant of the Badger Manufacturing Corp., Milwaukee, Wisconsin, makers of automobile bumpers.

At left:
An I-R Air Hoist used in the electroplating process at the Badger plant.

Reduce Your Compressed Air Costs

Why not reduce compressed air costs by installing oil engine compressors of the right kind?

Direct-connection, high thermal efficiency of the oil engine, and a correctly designed compressor all combine to make this type of unit the most economical means of producing compressed air.

Ingersoll-Rand Oil Engine Compressors are to be had in various capacities and for numerous working pressures. Let our engineers know your requirements. They will tell you of 600-cubic-foot machines that now operate at a fuel cost of only 36 cents an hour. This means 1,000 cubic feet of free air for 1.2 cents.

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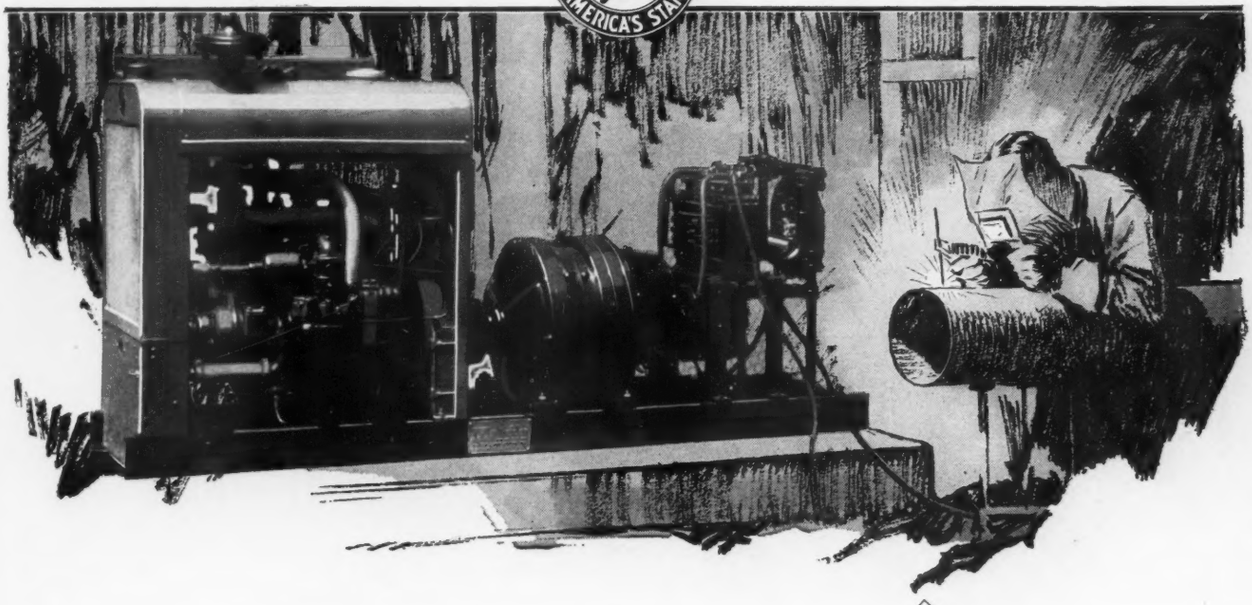

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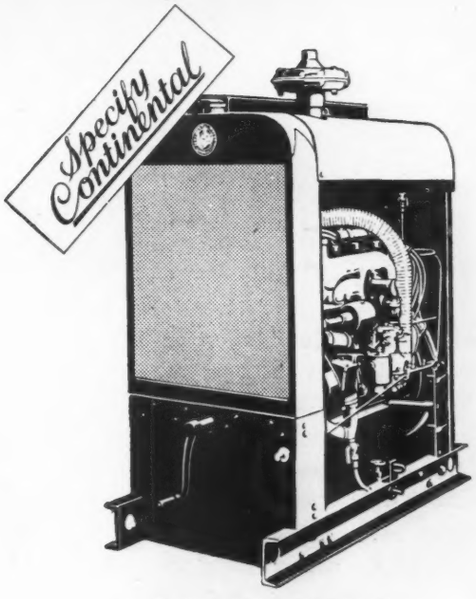
The recognized leadership of heavy-duty Red Seal Continental Motors has been earned by the experience gained through designing and producing hundreds of models and millions of motors.

Where industry flourishes and efficiency holds sway Red Seal Continental Motors play a dominant part. Their long life and economy are outstanding in industry throughout the world.



Welding Unit built by U S L Battery Corporation and powered with heavy duty Red Seal Continental Industrial Power Unit Model P-35.

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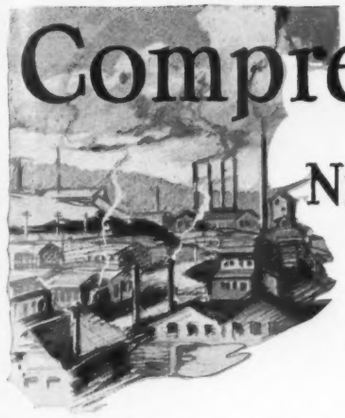

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JANUARY, 1928

Pumping Cost Cut Seventy-Odd Per Cent

Norman, Oklahoma, Has Done This By Adopting Oil-Engine Drive in Municipal Water Works

By R. G. SKERRETT

AN ample supply of water is rapidly becoming a matter of increasing concern to many cities and lesser communities. Not only that, but the insistent demand is that the water shall be good as well as abundant. Statistics show that more and more water is used per capita with each passing year; and the taxpayer objects vigorously whenever the water supplied him in his home or in his place of business costs him more than formerly.

Therefore, the alert managements of many of the country's water works are on the lookout for means that will enable them to cut down their operating expenses while maintaining or even increasing the volume of water delivered to their customers. To those officials the accompanying article should appeal, because it discloses how the City of Norman, Okla., has been able to effect very substantial savings by changes made in the pumping plant of the municipal water works.

NORMAN, Okla., lies near the center of the state and in the heart of Cleveland County, which has won for itself increasing prosperity by reason of the diversified crops grown upon the fertile farmlands. Norman is, therefore, a focal point for thousands of prosperous tillers of the soil. But this thriving municipality owes its growing importance in part to another and, in a sense, more far-reaching phase of its communal life. Norman is the seat of the University of Oklahoma—an educational institution of the highest order and one that is gaining steadily in prestige as well as in value to the state and the country at large.

While it is true that Norman can boast a number of industrial plants—all of them contributing measurably to the prosperity and the well-being of the municipality, still Norman is preëminently an educational center and is commonly known in the state as "The University City." And its enterprising Chamber of Commerce proclaims: "Norman is the ideal place for people to make their homes and to educate their children." It is the county seat of Cleveland County and is situated at an elevation of 1,171 feet above the sea on a plateau overlooking the valley of the South Canadian River. This valley is one of the most productive agricultural sections of the state. The climate is mild in winter and the heat in the summertime is much tempered by refreshing breezes.

The resident population of Norman is approximately 7,000, and this total is swelled by students attending the university. During the fall and winter semesters 5,000 students are enrolled, and during the period of summer school the attendance numbers in the neighborhood of 2,500. No inconsiderable percentage of the student body is recruited from Oklahoma City—the state capital—which is only 18 miles away to the north and linked with Norman by a hard-surfaced highway and by an interurban electric railway that provides an hourly service. Furthermore, Norman is on the main line of the Santa Fe Railroad.

Norman has fully 35 miles of sidewalks, quite 20 miles of paved streets, and has installed substantially 30 miles of sanitary sewerage. The streets are generally lined with trees that make the community one of the beauty spots of Oklahoma. It has a motorized fire department; and its up-to-date shops provide its citizens with everything they need in the way of essentials and luxuries. In addition to the university—representing at the time of construction a state investment of $2,500,000, there is located in Norman the Central State Hospital, which called for an expenditure of something more than $1,500,000. Incomplete as these figures and facts are, still they should be ample to give an idea of the part played by Norman in the industrial, educational, and social life of Oklahoma. Norman is going forward steadily; and those responsible for this progress are wide awake to everything vital to the success and to the well-being of the people within the city's gate. One of the outstanding contributions to this end is a fine water supply drawn from a group of artesian wells ranging in depth from 525 to 618 feet. The water so obtained is of notable purity and contains only a slight trace of soda. It has been analyzed by the state chemist, who has pronounced it: "The purest and most healthful soft water to be found in the state."

The wells do not flow naturally; and the water level, when at rest, stands 200 feet below the surface of the ground. Therefore, to raise the water and to distribute it through the city mains it is necessary to employ pumping facilities of one sort or another. This means that the city must maintain a pumping plant for the purpose; and the municipal government has found it expedient to install thoroughly up-to-date equipment so as to furnish water to the average user at a cost of not more than 60 cents per 1,000 gallons, and to deliver it to the people of Norman without involving an annual monetary loss. To understand how this has been done it is essential briefly to outline conditions prior to the latter part of 1926.

Imposing group of university buildings.

Previously to the fall of 1926, power in the pumping plant was supplied mainly by steam—two boilers, each of 150 hp., being provided for that purpose. Only one boiler was used at a time. The fuel burned was gas at an average cost of 20 cents per 1,000 cubic feet over and above the first 1,000 cubic feet—the latter costing 80 cents. Gas was found less expensive for steam raising than fuel oil at approximately 4 cents a gallon.

Steam was utilized principally to drive three air compressors, installed at various times as the demand for water increased, and to operate a centrifugal pump which takes the water from the reservoirs at the pumping plant and delivers it to a standpipe from which the water is distributed under suitable pressure through the city mains. The compressors have furnished the air needed to operate the air lifts that raise the water from the five wells to a height whence it will flow by gravity to two reservoirs that have a combined capacity of 380,000 gallons. The water level in the wells drops to 250 feet below the ground surface when the air lifts are working to capacity, and the air lifts must, therefore, raise the water slightly more than that in order to bring it up to the discharge ends of the lifts.

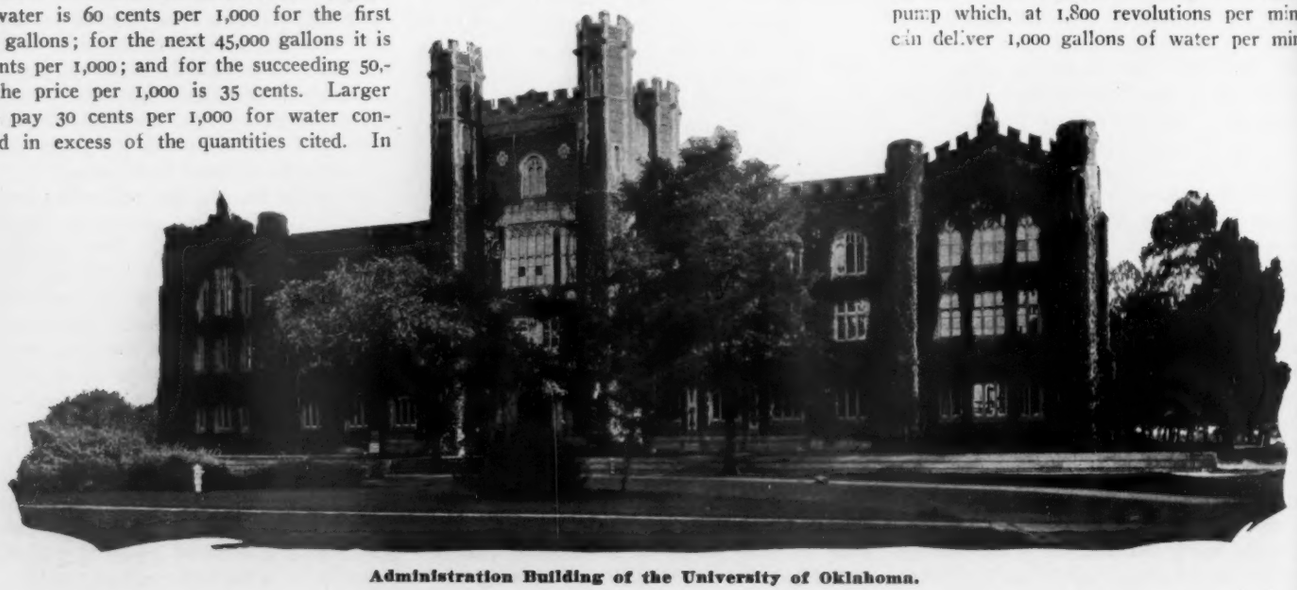
During the fall, the winter, and the spring, the average daily consumption of water is 500,000 gallons; and the demand increases to 800,000 gallons a day in the summertime. All water used is metered; and recently meters were placed on the premises of 200 additional customers. As has been mentioned, the price for water is 60 cents per 1,000 for the first 5,000 gallons; for the next 45,000 gallons it is 40 cents per 1,000; and for the succeeding 50,000 the price per 1,000 is 35 cents. Larger users pay 30 cents per 1,000 for water consumed in excess of the quantities cited. In meeting current requirements with the steam plant in 1926, the city paid $13,180 for fuel and $150 additional for lubricating oil—making a total of $13,330 for fuel and lubrication.

Norman has a commission-managerial form of government, and during 1926 the wide-awake authorities in office decided that the community could save money by providing a new and a much more efficient pumping plant—retaining the steam plant as a stand-by only. After a careful and thorough survey of the field, the city elected to adopt oil-engine drive for its operating units. In making this choice, the commission was guided by high engineering talent—Mr. W. W. Kraft, superintendent of college utilities at the university being the consulting engineer employed.

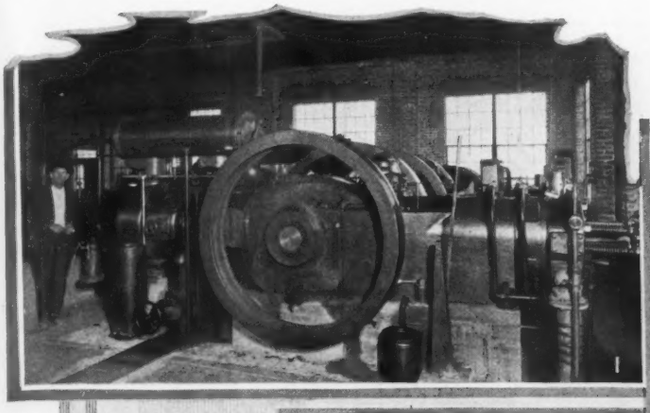
As now equipped the plant contains one 55-hp. PO engine and two 110-hp. POC-2 oil-engine-compressor units. The 55-hp. engine drives a 10-kw. General Electric generator, which produces direct current at 125 volts, and also a centrifugal pump having a capacity of 600 gallons a minute against a head of 140 feet. The pump and the generator are belt driven from the flywheels of the engine. The pump takes water from the near-by reservoirs and delivers it to the standpipe, which has a capacity of 87,000 gallons.

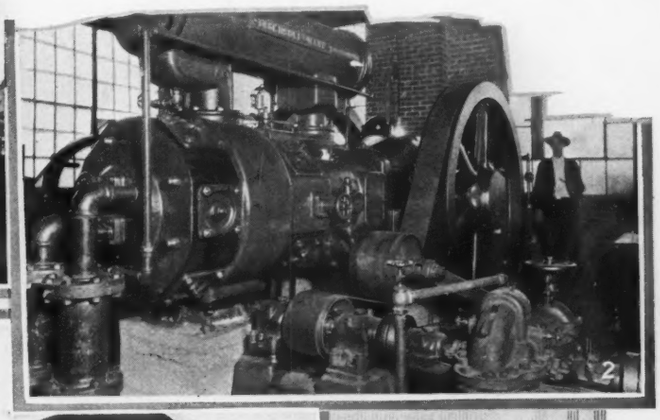
The generator furnishes current for lighting the pumping plant, the city hall, and the street between the pumping plant and the municipal building. Before the 55-hp. oil engine was bought, the city purchased current for lighting—the cost therefor averaging $60 a month. The oil engine costs $2 a day to operate and, therefore, provides electric current and does the needful pumping at a total outlay of $60—performing two indispensable services for a sum that was previously paid for only one of them. It may be interesting to note here that the 55-hp. oil engine has been running continuously since January 25, 1927; and it was shut down on that date for a brief period of five minutes when a leaky joint in a fuel-supply line was tightened. The engine was then stopped only because the tightening could best be done in this way with assured safety to the workman.

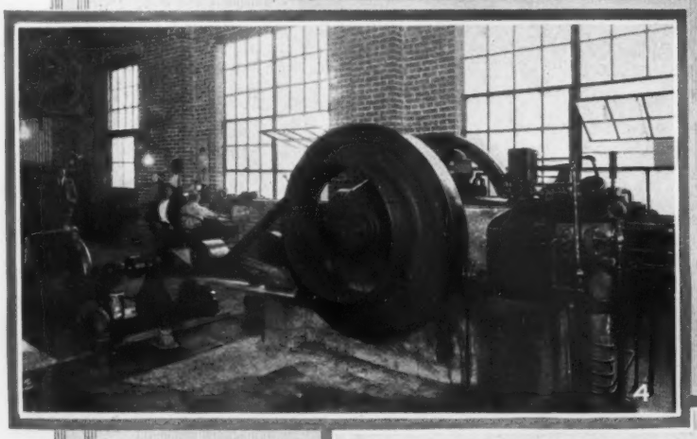
Compressed air for operating the air lifts in the wells is furnished by the two oil-engine compressors that alternate in service—one of these 110-hp. machines being of sufficient capacity to take care of the air needs of the five lifts. Between the two POC-2 oil-engine compressors there is placed a No. 5 LV Cameron pump which, at 1,800 revolutions per minute, can deliver 1,000 gallons of water per minute

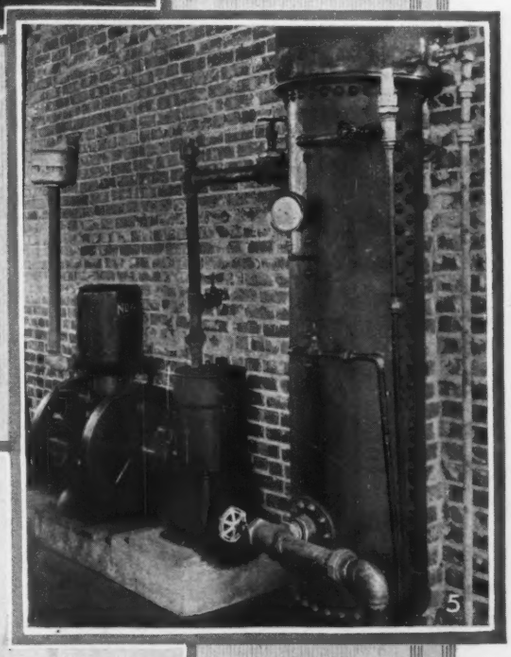


Administration Building of the University of Oklahoma.









1—One of the two 110-hp. POC-2 oil-engine compressors that furnish air to operate the air lifts that raise water from five deep artesian wells.
2—Between the two oil-engine compressors there is a stand-by Cameron pump, capable of delivering 1,000 gallons of water a minute. This pump can be belt driven by either oil-engine unit.
3—Power and pumping plant of the water works of Norman.
4—This 55-hp. Ingersoll-Rand oil engine drives a 600-gallon centrifugal pump and a 10-kw. electric generator.
5—Compressed air for starting the oil engines is furnished by a small gasoline engine driving an I-R Type 15 compressor. Air for this purpose is stored in the associate receiver.
6—Close-up of one of the five wells from which water is raised by air lifts.

against a head of 140 feet. This pump is so mounted that it can be belt driven from the near-by flywheel of either of the 110-hp. units. The purpose of this arrangement is to provide a stand-by pump that can be called into use in case of fire to supplement the pump operated by the 55-hp. oil engine or to take over the pumping load when the 55-hp. engine is shut down. In this way is insured an ample supply of water to meet either current demands or an emergency—in short, it is a flexible installation that can meet all probable conditions.

A commemorative gateway to the university grounds, erected by the class of 1919.

Air for starting purposes can be obtained from an I-R type 15 compressor actuated by a 6-hp. Novo gasoline engine. This starting unit is used but infrequently, because sufficient air is generally available in the two main air receivers that are placed just outside of the pumping station. Fuel oil is transferred from an outdoor tank to a tank inside the building by an air-operated steam pump.

Inasmuch as the three oil-engine units were installed for the purpose of saving money—that is, cutting down the expenses incurred when operating the plant by steam and using gas for fuel, it may be of interest to compare the results obtained during the interval beginning February 1 and ending September 30, 1927, with the operating costs during the corresponding period in 1926.

For the eight months mentioned, in 1926, gas and lubricating oil for the steam plant came to $8,099.44. Fuel oil and lubricating oil for the oil-engine units for the same length of time in 1927 cost $2,060.66, representing a saving of $6,038.78 or a reduction of 74.56 per cent! This saving is relatively larger because the water consumption, and, therefore, the amount of water pumped is substantially 8 per cent. greater now than it was in 1926. Furthermore, the insurance commission requires that the reserve steam plant shall be operated each month for 2½ hours; and steam is raised for this short run with fuel oil. The fuel oil burned under the boilers in that 2½ hours is sufficient to run the oil-engine equipment for one full day. This fuel consumption is included in the total attributed to the oil-engine plant during the 8-month period of 1927.

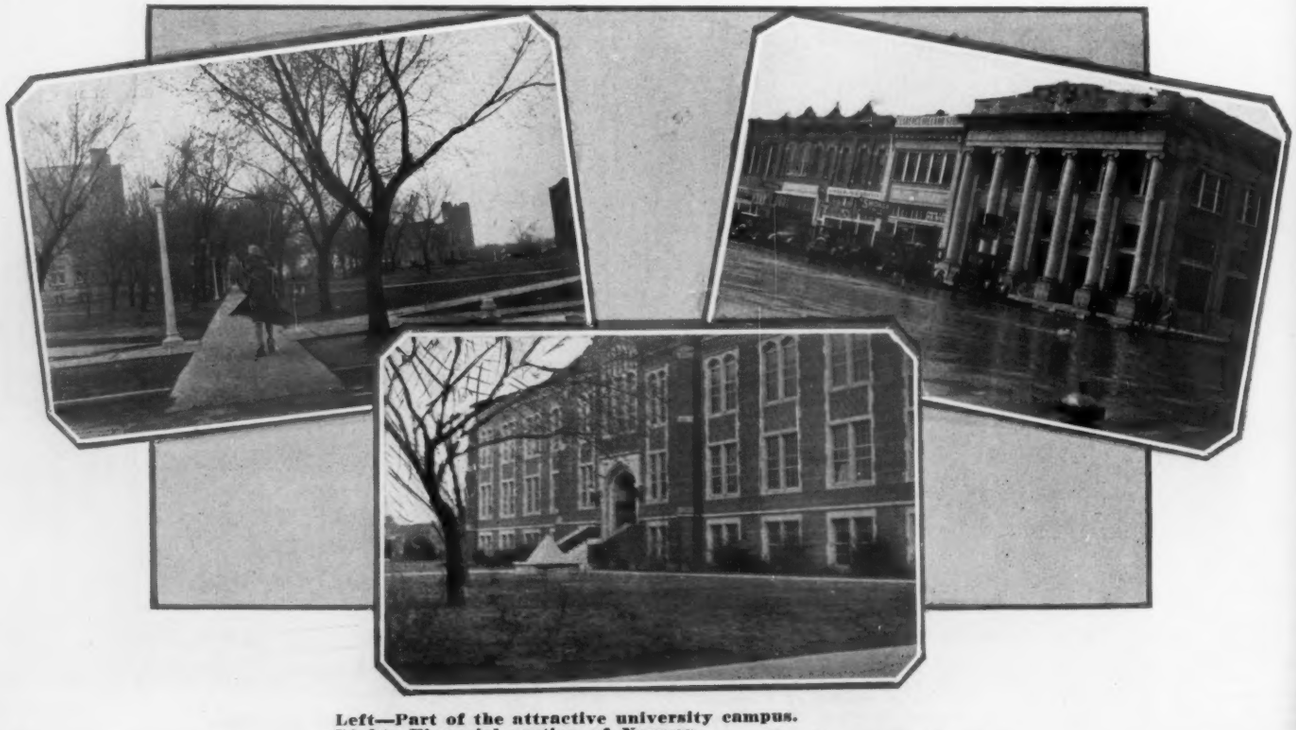
With economy and efficiency as their ultimate aim in providing the municipal pumping plant of the City of Norman with oil engines, it is easy to understand why the mayor, Mr. Guy Spottswood, the commissioners, the city manager, and the engineer directly in charge of the plant should be very enthusiastic over the showing made—especially when the results have far exceeded the expectations of the city officials. At the present rate, Norman could replace its oil-engine installation every three years—to be exact, every two years and eight months—on the savings effected in the interval! Surely what has been achieved by Norman should be of interest to many other towns and cities having a similar problem.

PAPER FROM BAMBOO

EXPERIMENTS with bamboo for the making of paper have reached such a stage in India that the government feels justified, according to W. Raitt, cellulose expert to the government, in building a factory large enough to try out the process on a commercial scale.

In a recent address to the forestry section of the British Association, Mr. Raitt brought out that the problems of chemical reduction and of bleaching, which at first seemed insurmountable, have all been overcome; and it is his opinion that it will be quite possible to furnish England with bamboo pulp at less cost per ton than wood pulp. The supply of bamboo in India is said to be almost unlimited and large tracts are being held in reserve by the government for future development.

A potash deposit of considerable promise is said to have been discovered at Malagash, Nova Scotia.



Left—Part of the attractive university campus.
Right—Financial section of Norman.
Bottom—Engineering Department of the University of Oklahoma.

BOOSTING A SAWDUST CONVEYOR

SAWDUST disposal is one of the most harassing problems around the average woodworking plant; and as the storage yard of the Ocowea Lumber Company began to fill with stacks of seasoning timber the sawdust pile became a fire menace as well as a space-consuming nuisance. The boiler room utilized the slabs and the shavings from the planers and the edgers; but the vast output of sawdust had to be carried through an air line to a dump, thence to be carted away as scattered markets were found, or it had to be burned if no profitable disposal offered.

Daily the huge pile grew, and the management contemplated the erection of a costly waste-burner as the only feasible means of ridding the plant of its unwelcome by-product. Then the sales department discovered a buyer for the sawdust in an industrial city some hundred miles away, and shipment of the material by rail was begun. It proved impossible to crowd tonnage enough into a car to make the stuff pay its own freight, and therefore advantage was taken of a nearby waterway to ship by barge.

The canal was a scant 200 yards from the dump; but, even so, it was necessary to load the waste into wagons and haul it up a stiff incline in order to dump it into bins, from which it was chuted into the boats. This method of disposal was expensive; and at the end of the first month the company found it was actually paying a premium for the privilege —for that is really what it amounted to—of dumping the refuse into barges.

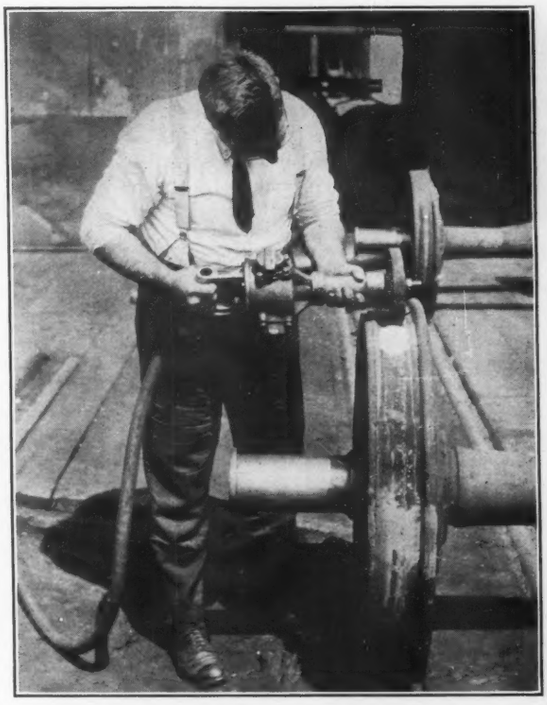
Representatives of an air-conveying system were consulted; but they vetoed the lengthening of the existing air line because the units in use were already being forced to the limit to carry the sawdust to the dumps. A secondary conveyor was considered, and this was to pick up the sawdust at the point of discharge and deliver it to the loading bins. Again, the cost seemed prohibitive, and the matter was allowed to rest.

Only Frank Lynch, cub draftsman in the Ocowea office, kept plugging away at the problem, and finally went to his chief with the suggestion that the conveyor be extended to the barge wharf by installing a booster near the end of the present conveyor system. The proposed booster consisted of a 3-hp. motor driving a turbo-blower with a 4-inch discharge pipe that was to be led into the delivery main. This stream of air was designed to accelerate the lagging sawdust and to carry it the additional distance to the bins.

On paper the scheme appeared quite feasible, and the management approved it. But the first day the device was put into service the pipe clogged: jammed tight just back of the point where the booster was connected. Experiments showed that this condition was caused by an eddy forming below the booster inlet and behind an upright piece of pipe, by means of which the booster line was brought into the main discharge system. This pipe had been placed in the most convenient manner—from below, and the sawdust naturally tended to collect in the stagnant air. The booster line was then made to enter from the top of the conveyor; and, as an added precaution, a narrow slit was cut in the discharge or down-stream side of the booster inlet, from the main wall to the elbow, so as to permit a thin "blade" of air, under pressure, to emerge and to create a forced draft around any obstruction.

The incoming high-pressure air seemed to "bunch" and to cause eddies in the conveyor because the high-velocity booster air had a tendency to expand and, apparently, to create a slight back pressure in the line. This bunching resulted in the upbuilding in the tube of piles of sawdust which could be dislodged only by thumping the line. This was obviated by installing a cone in the mouth of the booster discharge pipe so that the air under pressure could be directed outward toward the walls of the conveyor. Once the cone was properly set, no further clogging occurred.

Due to the fact that the booster picked up the sawdust while it was still suspended and in motion, and there was therefore no initial inertia to overcome, the material could be moved the remaining distance at a power cost of less than one-fourth the figure computed by the conveyor engineers. The booster was likewise automatic in its action—requiring no supervision other than that given the other units of the conveying system. After this system was perfected, the vexatious by-product became a source of revenue.



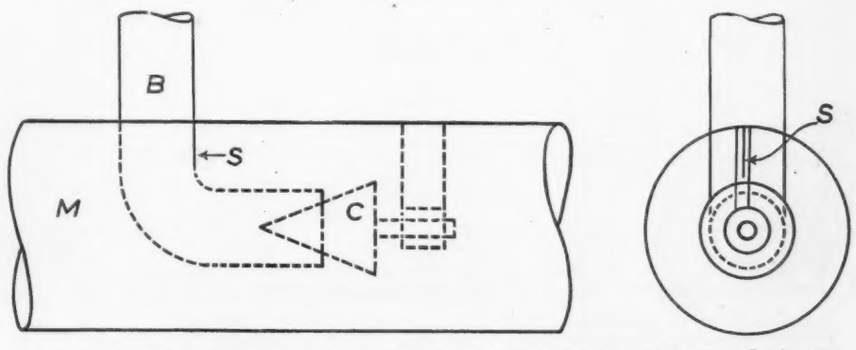
This air-driven grinder is being used in a railroad shop to round off flat spots on car wheels. The flat spots are the result of the wheels sliding and wearing when the brakes are applied too forcibly.

CLEANING CAR SEATS BY SAND BLASTING

UNTIL recently, the cleaning of rattan-covered car seats and cushions that have become discolored and grimy with wear has been a troublesome job. The practice has been to wash them; but even the use of strong compounds did not serve to restore their freshness. This unsatisfactory work required much labor; something that did not meet with the approval of the enterprising management of the Androscoggin & Kennebec Railway Company.

In looking about for a more practicable means, it was discovered that it was possible by the aid of the "Multiblaster" bench-type sand-blast gun to make the seats look like new, and to do this at a considerable reduction in labor and cost. Fine sand is utilized in the gun so as not to remove the protective coating of paint or varnish.

The statement is made in *Power Plant* that the United States, with about three times the population of England, has seven times as much capital invested in the electrical industry and produces twelve times as much electric energy. This is sold to ten times as many customers.



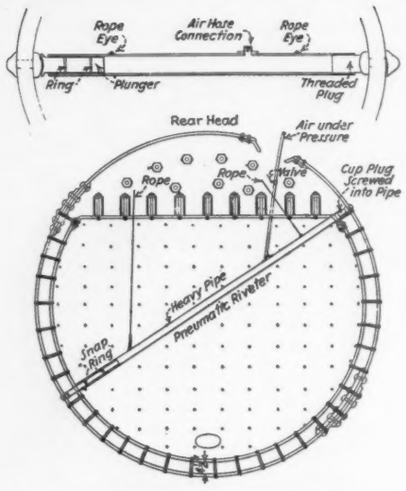
Longitudinal and cross sections of the pneumatic booster for a sawdust conveyor. B, booster pipe; C, deflector cone; M, discharge main; and S, anti-clogging slot.

Rivet Driving in Cramped Places

DRIVING rivets in cramped or awkward positions is a problem that confronts the repair or maintenance man just once so often. Even though it may be difficult to drive the rivet, still the rivet must be driven and driven securely if it is to perform its function properly in the structure of which it is an essential part. To meet these requirements, special apparatus are at times needed—some of them for general service and others to satisfy the demands of an emergency. An example of the latter sort was well described in an issue of *The Boiler Maker;* and we abstract freely from that excellent publication.

A boiler of the Scotch marine type called for the immediate renewal of the lower half of the head—the boiler being the only one available in the plant. After removing the defective part of the head, it was found upon investigation that considerable work would be necessary in riveting the new half head to the shell. There was but 4½ inches of space under the combustion chamber; and at the side sheets the free space was equally restricted. The width of the combustion chamber, therefore, made the usual procedure of holding-on virtually out of the question in driving the new rivets. Something had to be done and done quickly.

The foreman surveyed the situation, and asked the diameter of the boiler. Returning to the shop he had a pneumatic holder-on made which he thought would do the work easier and quicker than a man and at less expense. This device consisted of a piece of extra-heavy pipe, bored at one end, into which was inserted a cup-head piston with two snap rings fitted to the piston. At the opposite end was screwed a cup-head plug; and a threaded pipe was welded at a point nearest the closed end through which the compressed air entered the pipe. The air was admitted or released by a 2-way cock from an air line within operating



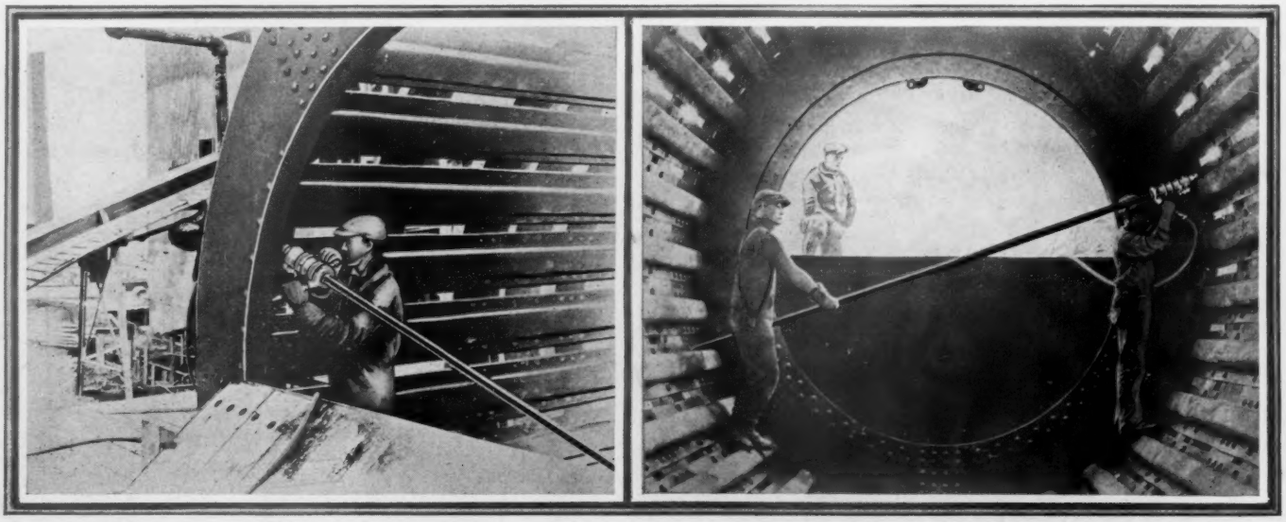
Pneumatic holder-on devised by an ingenious foreman in making hurry-up repairs on a Scotch marine-type boiler.

distance. A couple of rings were also welded to the pipe, and to these were attached ropes leading to the top of the combustion chamber. When in service, one cup was put over a rivet already driven while the other cup was fitted over the rivet to be driven.

When ready for use, the apparatus was adjusted within the boiler; connections with the shop air line were made; the new half head was put in position and bolted; and the rivets, as needed, were heated and passed through the hand hole in the back head to a man inside the boiler. This man inserted the rivet in the hole and then fitted the piston cap over the hot rivet. A man at the top of the combustion chamber put the other cap over a rivet diagonally placed and turned on the air—the piston thus being forced up holding the rivet firmly while the boilermaker outside did the riveting. When a rivet had thus been driven home, the air was released by turning the valve. After that, the pneumatic holder-on was shifted to the next rivet hole by the aid of the aforementioned ropes, and the process was repeated. In this way, the circumferential riveting was completed much more readily and in much less time than had been expected. Besides, no more labor was required than would have been the case had the holding-on been done by hand. With the riveting finished, the pipe was easily removed by cutting it in two by means of an acetylene torch.

A tool of a permanent character for kindred work is the combination riveter and holder-on developed by the Ingersoll-Rand Company. This air-driven tool is used to back up rivets in somewhat awkward situations, and it does away with double gunning. It is employed extensively in paper mills in the erection and the upkeep of barking drums. These revolving drums strip the bark from the wet logs that are subsequently to be chipped or ground in making paper pulp; and, as can be readily grasped, the interior or barking surfaces of these drums are subjected to very heavy wear—the exposed rivets needing replacement at short intervals. Each of these drums has from 2,000 to 3,000 rivets, and these rivets must be kept tight. With a No. 7 combination riveter and holder-on, and a standard 9A hammer, as many as 40 to 50 one-inch rivets can be driven in the course of an hour.

The skyline of Sydney, Australia, is to be broken by a skyscraper. The structure in question, which is to be built at a cost of approximately $3,000,000 is to rise to a height of 300 feet. Thirteen of the floors are to be devoted to offices, while the upper 150 feet is to be in the form of a tower especially designed for use in connection with radio.



Here is an air-operated combination jam riveter and holder-on that has proved very efficient in upkeep work on barking drums. These drums, because of wear and tear, call for fairly frequent renewing of rivets; and the apparatus shown has aided materially in doing this necessary work well and quickly.

Portable Compressor Proves Big Aid in Feldspar Mining

By R. C. ROWE

IF we were asked about the mineral feldspar, most of us would probably disclaim acquaintance with it despite the fact that it enters into our lives several times a day. The dishes from which we eat contain it and also owe their glazed finish to it. Feldspar is an important ingredient in different kinds of porcelain, notably that used for electrical insulation. When finely ground, it forms an abrasive agency put in many scouring soaps and cleaning preparations, of which "Bon Ami" is a familiar example. The ground variety also is employed in the manufacture of stucco. These and numerous other applications make this little-known mineral one of considerable importance in the industrial and commercial worlds.

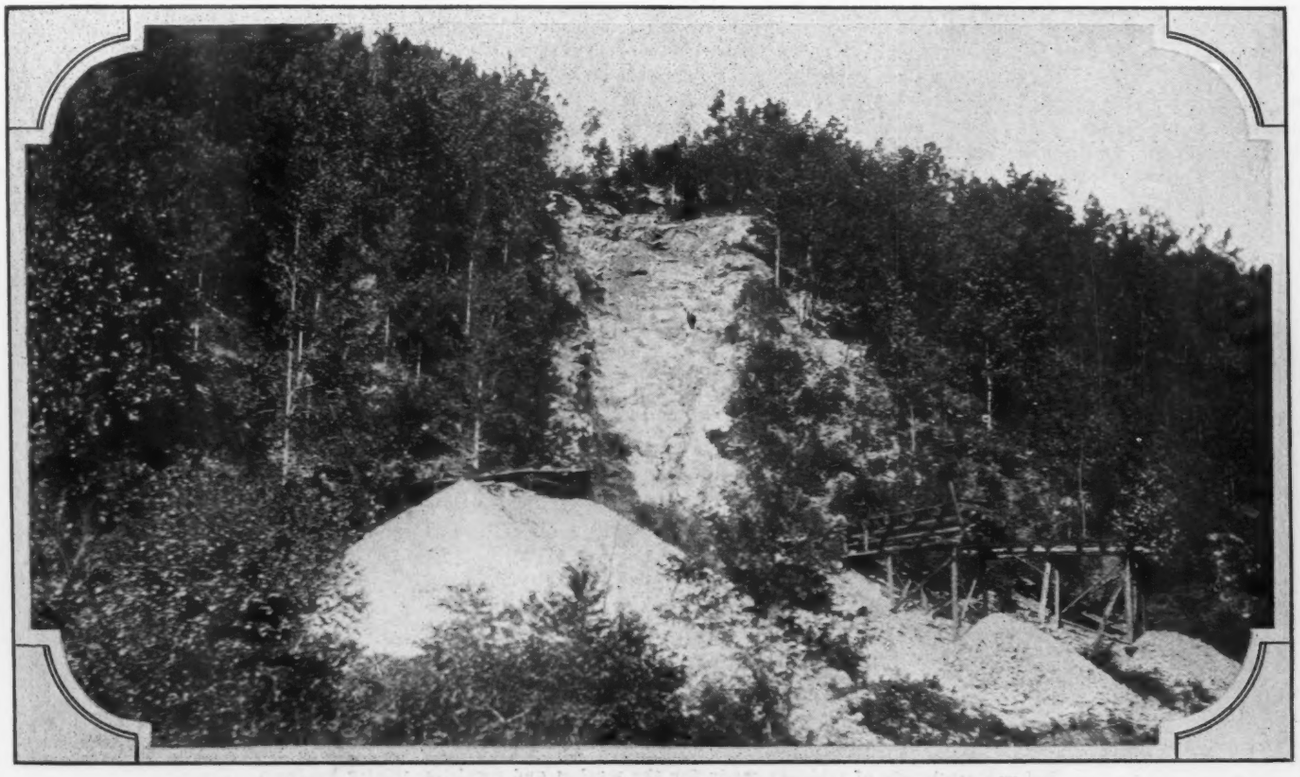
Feldspar is one of the commonest minerals in the earth's crust, and it is estimated that it makes up 60 per cent. of the contents of all igneous rocks. It is usually found in close association with quartz, and constitutes a large percentage of the great granitic masses that form the principal mountain ranges. The name feldspar is a general term that embraces a diversity of rocks that are essentially silicates of aluminum in combination with one or more of the minerals potassium, sodium, and calcium. Theoretically, there are nine distinct varieties—ranging from the *orthoclase* or potassium members, on one end, to the *plagioclase* feldspars, which include the sodium and calcium members and different gradations between them. Actually, the variations of the theoretical combinations are almost infinite in number. The feldspars have a high, vitreous luster and a good cleavage. Their hardness ranges from 6 to 6.4, or just below that of quartz. White, pink, and reddish-brown are the prevailing colors, and there is a green sort known as Amazon stone.

As it commonly exists, feldspar is widely disseminated among other rock minerals. Occasionally it is found alone in the form of dikes, and these are the sources of the commercial mineral. Such dikes are, properly speaking, generally pegmatitic—that is, they consist of quartz and feldspar, with both minerals exhibiting considerable crystallization. Sometimes great masses of virtually pure feldspar are segregated from the quartz and can be mined, ready for shipment.

An important source of feldspar is the Buckingham District of Canada, lying about 20 miles east of the City of Ottawa, in the Province of Quebec. The region is one of the oldest mining areas in the Dominion, and was the training ground for some of the best miners in northern Ontario today. Production there dates back 60 or 70 years, and includes various non-metallic minerals—such as apatite, mica, graphite, and quartz—in addition to feldspar. All these minerals are found in or closely adjacent to the valley of the Lièvre River—the Rivière du Lièvre, according to old French nomenclature—which is a tributary of the Ottawa River.

The Buckingham District furnishes a typical example of the manner in which the portable air compressor fits into a well-laid-out plan of mining on a profitable scale in sections which are off the beaten path. The ease with which these units can be taken into well-nigh inaccessible places, their dependability of performance, and the marked savings that can be effected in operating costs make them especially suitable for such undertakings.

While the Buckingham District has for many years produced a high-grade dental spar used in the manufacture of false teeth, the mining of feldspar in large quantities is of comparatively recent inception. The existence of the deposits was well known, but no serious attempt to develop them was made until a few years ago when the M. J. O'Brien interests acquired and opened up what proved to be one of the most valuable feldspar dikes in North America. Considerable activity followed this initial venture. Other dikes were discovered,



A typical feldspar dike in the Buckingham District, with stock piles in the foreground.

and a boom seemed imminent. In the end, however, it was found that there were few high-grade deposits in the region; and the passing of the first flush of super-optimism left only a small number of operators in the field.

Since feldspar dikes are merely a differentiation phase of granite pegmatites, which are, in turn, a phase of granitic formations, feldspar dikes are likely to contain small amounts of the accessory minerals common to granite, such as mica, iron, chlorite, tourmaline, garnet, etc. If these are present in any considerable measure they will render an apparently valuable dike useless as a source of marketable feldspar.

In the Buckingham deposits, the percentage of contained mica and garnet is not objectionable. Such tourmaline as does exist is usually segregated so that it can be handled easily. Iron often discloses itself through rusty stains along cleavage seams; and chlorite and allied minerals leave a green stain. In some cases the occurrence of these minerals is more or less local, and such zones can be worked through to reach the purer feldspar. In other instances, where the dikes have a loose texture, staining along seams may continue indefinitely, rendering the deposit worthless.

Vugs or cavities are a common source of contamination. Stains resulting from the decomposition of accessory minerals contained in a vug may persist over a large area. There is little consistency in conditions. Thence, the mining of feldspar is an erratic business: the miners may be in clean spar today and in dirty spar tomorrow. It is for this reason as well as others, as will be shown later, that the portable compressor is particularly adaptable to this field of mining.

The feldspar belt starts about 9 miles north of Buckingham, which is the shipping point. The maximum distance from rail head, at which deposits can be worked profitably, is about 18 miles. Most of the haulage from the mines is done in winter, when the ice-covered roads make it possible to draw heavier loads. Obviously, machinery and supplies have to be taken in to the mines from the railroad terminal. The original power plants used in the

Officials of the Pennsylvania Pulverizing Company and some of the local employees of a Buckingham District feldspar mine.

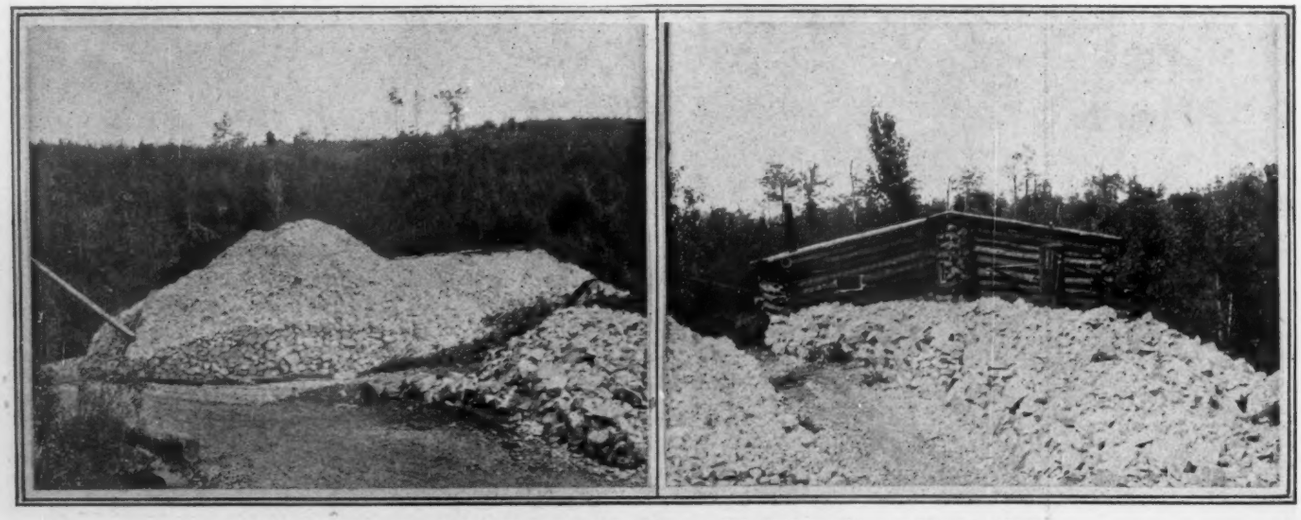
Buckingham region were steam driven. As is usual in such cases, the first piece of equipment to be dragged through the forests and over the hills to the scene of operations was a boiler. Years later, after almost every trace of activity in camps of this sort has disappeared, and most structures have rotted away, rust-flaked boilers may be found standing there as stark monuments to man's efforts to wrest wealth from Nature.

These boilers are left behind because haulage charges on heavy equipment are so great that it is frequently cheaper to abandon it than to move it out of a remote district. It is in connection with this item of freight costs that the portable, gasoline-driven compressor makes an especially good showing. A 5½x5-inch portable, complete with its 26-hp. gasoline engine, air receiver, fuel tank, etc., weighs only 2,800 pounds. A steam compressor of like capacity weighs 6,000 pounds and requires for its operation a 30 to 40-hp. boiler which has a weight of around 7,500 pounds. If this equipment is mounted on skids or wheels, then an additional 1,500 pounds will have to be carried. Besides, a steam-compressor plant consumes 45 pounds of coal per hour, whereas a portable needs only 17 pounds of gasoline per hour to run it—a further reduction, in favor of the portable outfit, in the matter of tonnage to be hauled.

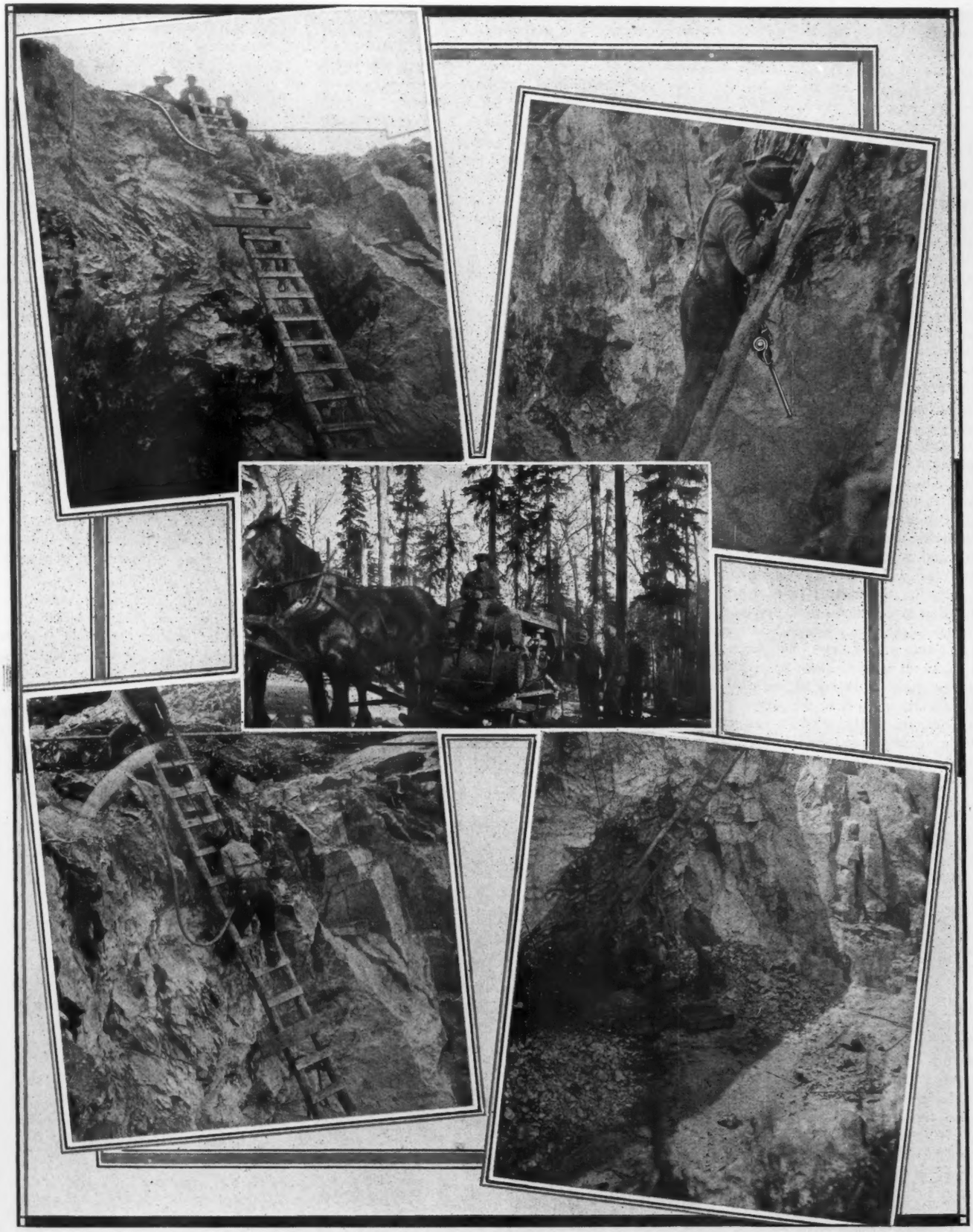
In the Buckingham area, the boilers furnished power for general mining purposes and for operating steam-driven drills. Next came steam-driven compressors and the "Jackhamer" drill. As is invariably the case in mining fields, there were many lessons to be learned through experience, and numerous conditions had to be met from time to time as they manifested themselves. Of these, the most troublesome was the varying quality of the feldspar. Under circumstances, even in deposits of the better grades, the wastage is great. It was soon found that men could not go to work on a dike and just blast out large masses of the pure feldspar. Careful sorting was necessary. While for days running the operations would be in clean spar, the formation had a vexatious tendency to change abruptly, and there would follow a period during which a contaminated zone would have to be penetrated when little if any spar of commercial value could be extracted.

Coupled with the physical characteristics of the deposits was the economic aspect whereby the maximum selling price of the product was more or less fixed by competition and freight rates. While the Buckingham feldspar is of a quality that commands the best returns, the maximum price is limited, as in the case of other commodities, by economic laws that are elastic only up to a certain point.

Mining of the dikes is generally carried on as a quarrying operation, although some attempt has been made at underground work. Quarrying is conducted by the bench system, and the usual methods of procedure prevail. Because of the mineral's perfect cleavage, care must be exercised in blasting least the feldspar be subjected to a fall that may badly shatter it and produce too great a proportion of fines. For



Left—A stock pile of feldspar ready for the market and awaiting winter haulage.
Right—Portable compressor plant, housed in a log structure, at the Cameron Mine.



The central picture of the group shows a portable compressor being hauled by sled over snow-covered roads from rail head to a remote Quebec mining property. The four corner views illustrate various phases of the drilling and the handling of feldspar at a quarry in the Buckingham District. "Jackhamer" drills are used to loosen the rock prior to barring it down.

the same reason, drill holes have to be loaded lightly; the most desirable effect being one of springing. Because of the highly developed cleavage, the rock for a considerable distance around the drill hole is thus loosened so that much of it can be barred down. No rules of procedure can be formulated, as the feldspar in some dikes is more fragile than that in others, and the most suitable practice can be determined only after actual experience.

Because of these variable factors, it was soon learned that mining at Buckingham called for more than blasting out large amounts of high-grade feldspar. The margin of profit was not large at the best, and it was apparent that this profit could be maintained only by adopting and following the most advantageous and economical mining practice. It was in furtherance of such a policy that the gasoline-driven portable compressor was brought into play. For those interested, the reasons for its adaptability are briefly set forth.

As has already been stated, mining is done principally by the open pit method. Feldspar is an easy-drilling rock, and one man with a "Jackhamer" can readily put in 120 feet of hole a day. Owing to the texture of the dikes, this footage is sufficient to break out a lot of rock. Drilling operations are therefore intermittent. This means that where the quarry is cut into a hill and where no hoisting is required the power plant will be idle for a good part of the day. During the early stages of the operations, when steam plants were employed, it was necessary to carry on the payroll a certain class of labor that was at times unproductive. Further, as steam had to be kept up even when the plant was merely standing by, the cost for fuel was out of proportion to the service rendered. The conditions clearly called for equipment that could be readily started and stopped; that demanded a minimum of attention while running; and that ceased to be a source of operating expense when idle. Gasoline-driven compressors met those requirements in every way.

The first compressor of this type in the district was an Ingersoll-Rand machine that was run by belt from a Fordson tractor. It was placed in service by an enterprising French-Canadian who was blessed with the name Gonzague Pednuade. Later on, direct-connected gasoline compressors were introduced. At the Northern Feldspar Company's quarry at Hyblu, Ont., for example, a 5½x5-inch Type 20 unit is used. Such an air-producing plant needs little attention. The foreman starts it up in the morning; watches it for a few minutes to make sure it is functioning properly; and then goes on about his duties. When drilling is finished for the time being the unit is shut off, and the fuel cost stops. Operations can be resumed instantly whenever desired.

Portability is not essential to the compressor equipment in this particular field—the machines are more or less permanently installed and are properly housed. The same characteristics that have made the portable compressor a valuable aid in feldspar mining have also led to its adoption in quarrying limestone, gypsum, barytes, and similar non-metallic minerals in different parts of Canada. The machines used vary all the way from the 5½x5-inch size to the 10x8-inch size, although the smaller units are probably in the lead.

For drilling feldspar, BCR-430 "Jackhamers" are now in general service throughout the Buckingham District and have proved very satisfactory. In many of the gypsum-producing properties, CC-35 paving breakers are being successfully employed to break up large pieces of the blasted rock, thus preventing blockholing.

After quarrying, the practice is to sort the broken feldspar into three groups: firsts, seconds, and rejects. The firsts consist of clean, high-grade feldspar, which is taken direct to stock piles. The seconds, which include all questionable material, are put aside for further sorting. Such impurities as are visible are cobbed off, and the resulting product is sent to the stock piles with the firsts. The rejected material from the pits and from the cobbing piles goes to the waste dumps. Usually the crude stock-pile feldspar is divided into three grades; but, because of the high freight rates, only the No. 1 or best grade is shipped from the Buckingham District.

The *orthoclase* or potash feldspar has the greatest commercial value, being used chiefly in the ceramic industries and in the making of pottery, electrical porcelain, and related products. It also is utilized as a binder in the manufacture of carborundum and emery wheels. The lower grades of the same variety and the soda-lime feldspars find their way into scouring soaps, stucco, chicken grits, etc. The Buckingham feldspar is a high-grade *orthoclase* with a potash content of around 13 per cent. and with little free silica. Substantially the entire output is shipped to grinding mills in the United States.

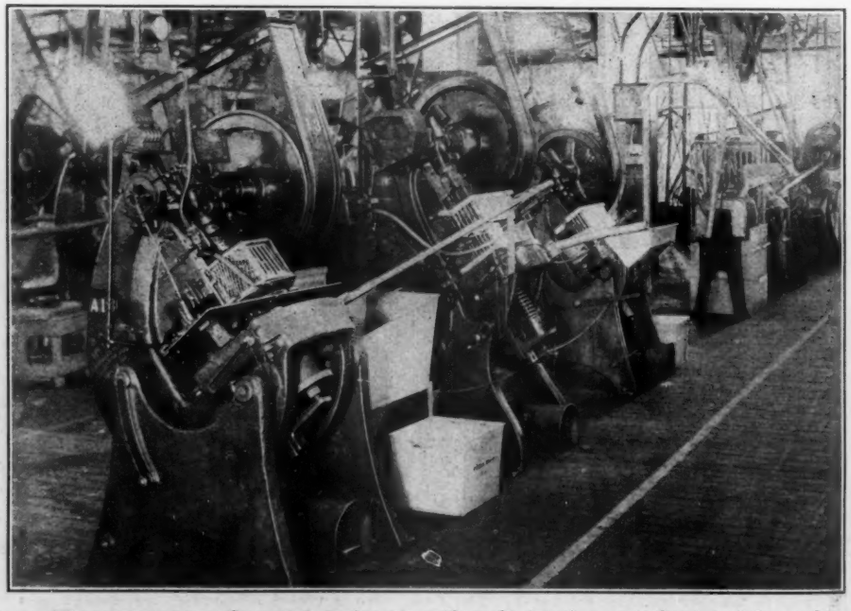
An electrical radiometer that makes a written record of the ultra-violet content of sunlight has been invented by Doctor Pettit, a government scientist working at the Solar Observatory in Pasadena, Calif. This instrument is coming into service in hospitals where the curative powers of sunshine are being made use of.

COMPRESSED AIR FEEDS GROUP OF PRESSES

COMPRESSED air plays an important part in the operation of a group of six punch presses and one threading machine utilized in the mass production of nozzles in the factory of the American Can Company, Maywood, Ill. This plant turns out daily a total of 65,000 nozzles used principally on syrup containers. The machinery in question is hooked up in such a way that the nozzles are conveyed from one press to another through a series of tubes by blasts of compressed air. This arrangement makes quantity production possible. Moreover, only two operators are required: one at the feed end and another at the discharge end to inspect the finished work as it issues from the last of the machines.

In the making, the nozzles first go through the cutting press, and are then successively blown from die to die for redrawing, trimming, resizing, threading, and for having gaskets fitted—in short, everything is done automatically. This insures necessary interchangeability and a tight fit on the can.

The connecting carriers or tubes are of galvanized iron, and their inside diameter is but a little larger than the maximum diameter of the nozzles. This keeps them right side up while in transit or in the position in which they must reach the dies. After the completion of each operation, the nozzle is pushed off the die into its associate carrier by the nozzle next in line. The air pressure needed to force the work through the tubes depends upon the weight of the nozzles.



These presses perform successive operations in turning out sheet-metal nozzles for syrup cans. As each operation is finished, the developing nozzle is conveyed to the necessary presses by means of compressed air. In the course of a day the battery of six presses and one threading machine produces 65,000 nozzles.

International Foundry Exhibition

SOUND and otherwise satisfactory castings are matters of the utmost importance to many departments of industrial life the world over. Therefore, unusual interest was aroused a while back by The International Foundrymen's Convention and The International Foundry Exhibition held in Paris under the auspices of the French Association Technique de Fonderie.

M. Queuille, French Minister of Agriculture, is the smiling gentleman in conversation with attendants of the Ingersoll-Rand exhibit.

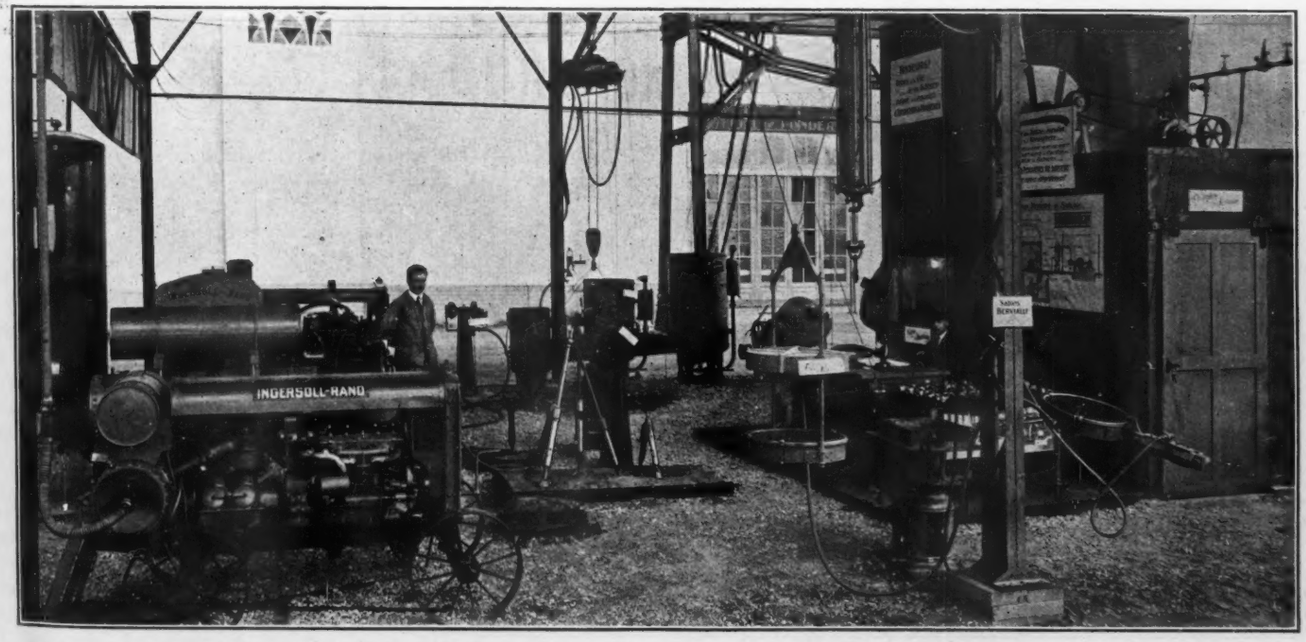
The fact that the convention and the exhibition occurred at the same time helped greatly to increase not only interest in each but to augment the value of both. That is to say, much that was covered by the papers read and discussed during the convention could be visualized and emphasized by the equipment and the products displayed at the exhibition. During the meetings of the convention, many problems concerning the foundry industry were treated; and the papers presented were for the most part written by prominent European foundrymen.

The formal opening of the exhibition was marked by an address by M. Queuille, Minister of the Department of Agriculture, who was accompanied by M. Dufour, President of The International Foundry Exhibition, and other distinguished officials. Among the products that arrested considerable attention were a cupola and hydraulic molding machines, that ran daily. This exhibit was installed by Bonvillain and Ronceray of Choisy-le-Roi, France. Other French concerns were also conspicuous because of their displays; and machinery and equipment made by certain well-known German and Italian firms also attracted much attention.

Because of the *rôle* now played by compressed air in the up-to-date foundry there were exhibits of air compressors, pneumatic tools, and sand-blasting apparatus. The Ingersoll-Rand Company gave over the largest part of its space to a complete range of air-driven tools such as are now to be found in typically modern foundries; and to add still more to the arresting value of this display, the company showed many of these facilities at work under service conditions—skillful operators doing the demonstrating.

The nature of this display can be better grasped when it is learned that there were air-operated bench and floor sand rammers, chipping hammers, pneumatic grinders, core breakers, air hoists, vibrators, paint sprayers for blacking molds, sand-blast apparatus, and numerous other aids to the foundryman. Because of the temporary character of the installation, air for operating purposes was furnished by several I-R portable compressors. In this way, the company was able to make clear to all visiting foundrymen in how many ways compressed air can serve them in increasing production and in bettering their products while incidentally lowering operating costs. All of these essential gains are in keeping with the present trend towards quantity production—a phase of manufacturing which has been gathering impetus in Europe in recent years; following in this procedure the pace originally set by America.

The National Assembly of Czechoslovakia is said to have passed a law creating a highway fund of $30,000,000 to be allotted over a period of ten years for the construction and the maintenance of roads throughout the country.



Comprehensive view of the exhibit of the Ingersoll-Rand Company at the International Foundry Exhibition held in Paris not long ago. This display was awarded a grand prize.

SAWDUST NO LONGER A WASTE MATERIAL

DESPITE the fact that sawdust is commonly considered a well-nigh worthless material, many profitable uses for it and its product—wood flour—are pointed out in a bulletin recently issued by the National Committee on Wood Utilization, which is a division of the United States Department of Commerce. While many lumber mills still burn their sawdust to dispose of it, thousands of tons of this material and of wood flour are imported from Europe annually for utilization in American industries.

Between 10 and 13 per cent. of the saw log is converted into sawdust during the sawing process. As the United States produces some 52 per cent. of the world's lumber, it is obvious that vast quantities of sawdust result from each year's operations. In many cases, the mills are so far removed from points where the sawdust might be employed that the material is not worth the freight charges for moving it.

By far the widest application of sawdust is as fuel. Most of it is burned in its natural state; but considerable quantities are also made into briquets, either with or without a cohesive binder such as tar or resin. Sometimes coal screenings are added.

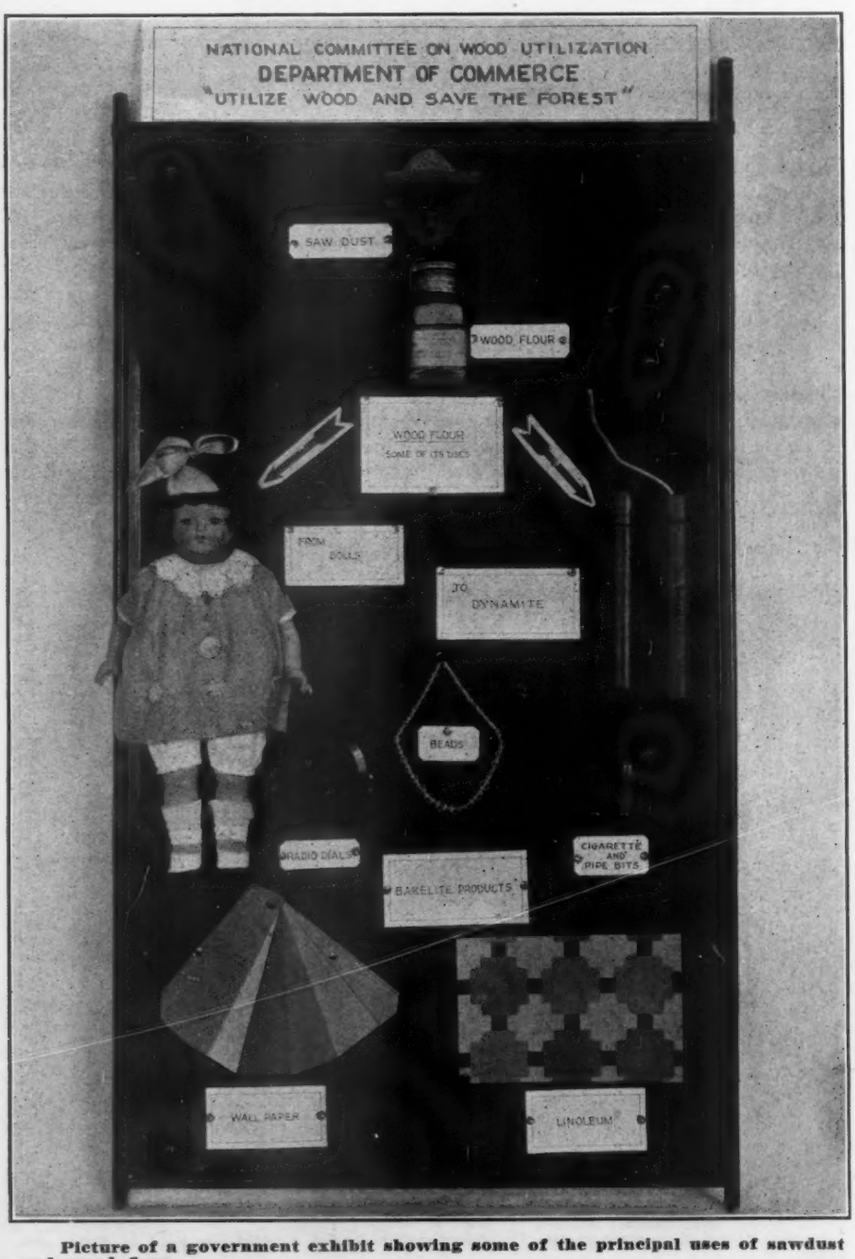
Markets and butcher shops use sawdust as a floor covering; in nurseries it serves, in a moist form, as a packing around the roots of trees and plants in transit; and more than 4,000 tons of it are utilized annually in California as a packing for grapes in shipment. The leather industry consumes about 1,100 tons a year in treatment processes technically known as "staking" and "tacking." It also is extensively employed for cleaning utensils and tubing of aluminum and other metals; for the conditioning of furs; for the smoking of meats; for the curing of freshly poured concrete; as an insulating material; and in the manufacture of bakelite and similar products, artificial lumber, and carborundum and allied abrasives.

Sawdust is being used with some success as a food for cattle, for which purpose it is first cooked and treated with acid to convert a percentage of its cellulose and allied substances into sugar. By distillation with steam, sawdust yields turpentine and pine oils; and by a process of destructive distillation it can be made to produce charcoal, pyroligneous acid, gas, wood tar, and other materials of value. Chemists have developed workable but as yet not commercially satisfactory methods for obtaining ethyl alcohol from sawdust. It serves as a base in most sweeping compounds; and it is widely utilized as a filling for dolls and similar articles.

Wood flour is merely finely ground sawdust—the grinding ordinarily being done between stones. The estimated annual production of this material in the United States is 24,000 tons, valued at about $750,000. In addition to this domestic supply, 6,413 tons were imported from Europe in 1926. Approximately 15,500 tons, or more than 50 per cent. of our yearly consumption of wood flour, enters into the manufacture of linoleum. Mixed with cementing materials—such as rosin, linseed oil, or kauri gum—it makes a tough, dough-like mass that serves admirably as a top coating for this popular floor covering.

Wood flour forms the filler for dynamite cartridges, and about 7,500 tons are employed for this purpose annually. With one of the phenol resins as a binder, it is molded into many useful articles such as radio dials, telephone parts, various sorts of handles, automobile radiator caps, etc. Sawdust in this guise is known by various trade names, among which bakelite is perhaps most familiar to us. Other molded compounds in which wood flour is an important constituent go into the making of phonograph records, bowling balls, brush backs, "unbreakable" dolls, etc. Composition flooring is composed principally of caustic-magnesia cement, with sawdust and wood flour added to give the material the proper resiliency; and fibrous wood flour is used to make what is known to the trade as "oatmeal" wall paper.

From the foregoing it will be seen that both sawdust and wood flour have a wide field of usefulness. However, there is still a great surplus—the supply is far greater than the demand; and the National Committee on Wood Utilization has set itself the task of finding other profitable applications for these by-products of the lumber industry.



Picture of a government exhibit showing some of the principal uses of sawdust and wood flour.

What is said to be a record in building construction for the North American Continent was made not long ago in New Westminster, B. C., Canada. The structure in question is 133 feet by 70 feet and 60 feet high, and required 1,500 cubic yards of concrete. The building was put up in 60 working days.

Salvage of German Fleet Off the Orkneys A Notable Achievement

Refloating of the Battle Cruiser "Moltke" Was Effected Largely Through the Buoyancy of Compressed Air

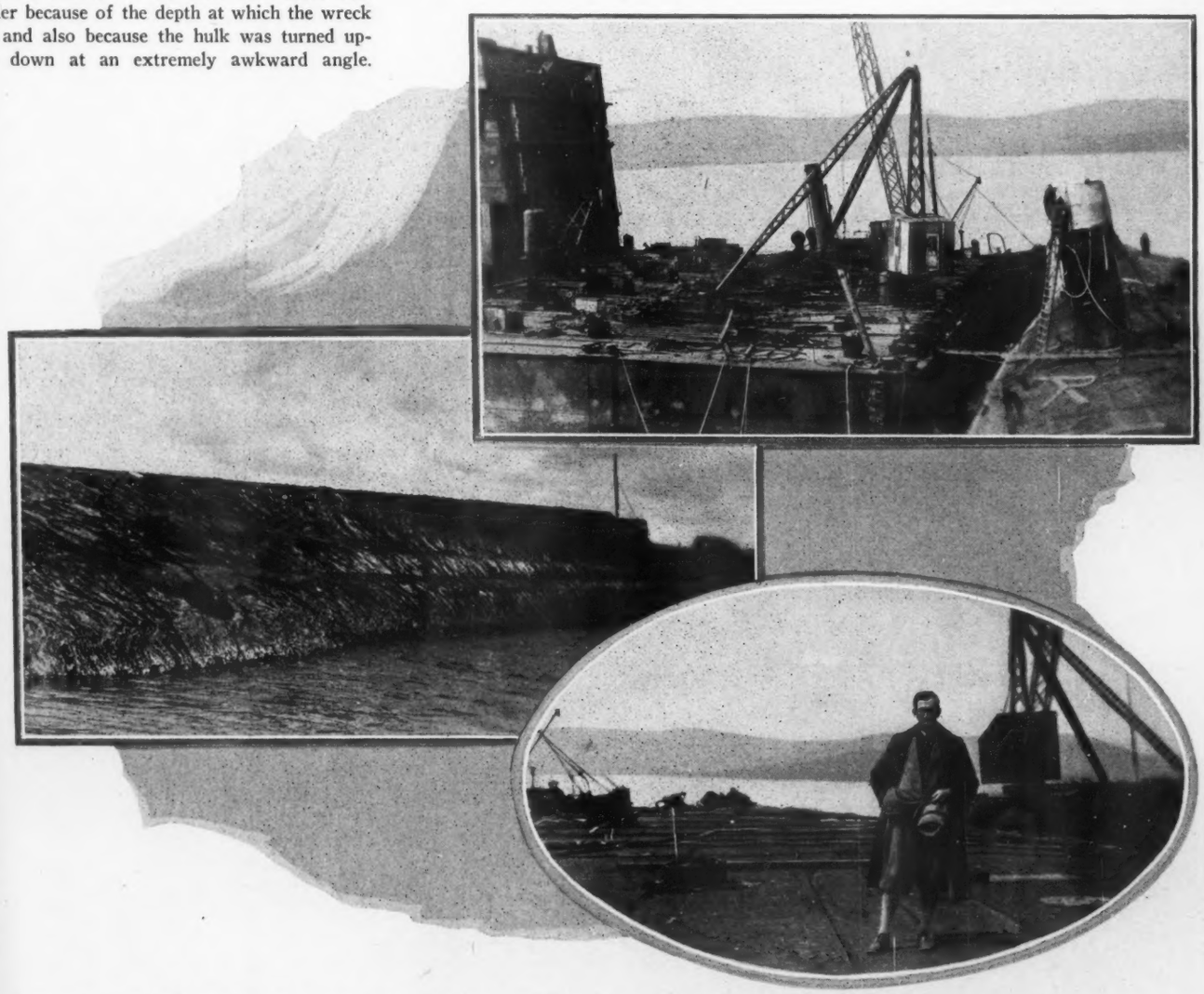
By ROLAND H. BRIGGS

RAISING the German battle cruiser *Moltke* from the sea bed by means of compressed air was an achievement of the highest order. The salvage was all the more remarkable in view of the stormy winds that frequently blow in the neighborhood of Scapa Flow where the great ship was sent to the bottom.

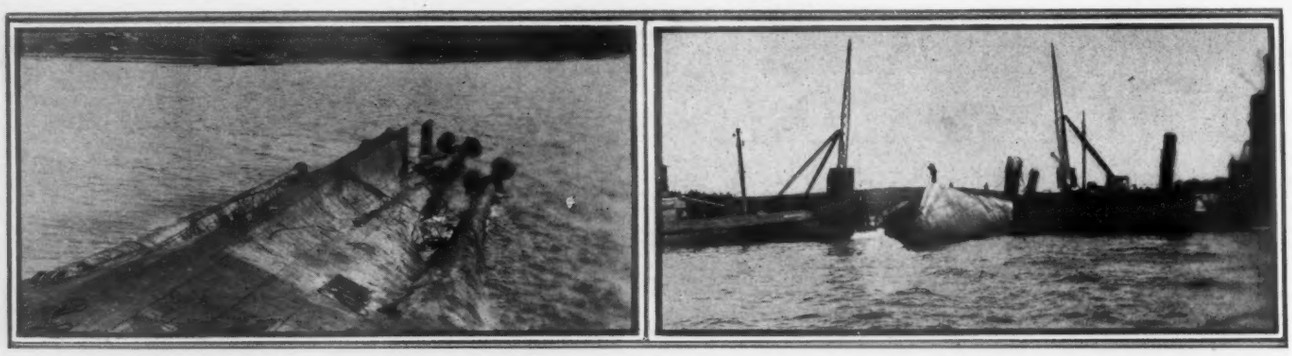
What was accomplished in the case of that ponderous vessel can be best understood when we recall the kind of weather so often encountered off the Orkneys, the extent of the tides, and the force of the currents that sweep the waters there. The task was made still harder because of the depth at which the wreck lay, and also because the hulk was turned upside down at an extremely awkward angle. Even so, Messrs. Cox & Danks, Ltd., attacked the problem undismayed; and the outcome is ample evidence of the skill displayed in refloating the ship so that she could be beached for deliberate demolition.

It will be remembered that, under the terms of the Armistice, the German Government was to surrender to the British Admiralty the bulk of her fleet, including a number of battle cruisers and destroyers, a large submergible submarine testing dock, and other naval auxiliaries. The last gesture of defiance of the German navy was the sinking of the cruisers and destroyers by the officers and crews who had been detailed to deliver the ships to the British. This act, while contrary to the obligations imposed by the various nations concerned, nevertheless received the sympathy of those who know what a vessel means to her complement.

Only an engineer of courage, imagination, and resourcefulness could have conceived the ways and means by which the ships in question were brought to the surface; and it was Mr. E. F. Cox—a prominent British salvor—



Left—The refloated "Moltke," turned bottomside up, ready to be towed ashore.
Top—One section of the submergible testing dock lying alongside the cruiser with the bow air lock by which the divers could enter and leave the boiler room of the sunken craft.
Bottom—Mr. E. F. Cox standing on the bottom of the "Moltke" after that vessel had been raised.



Left—The exposed stern of the 23,000-ton battle cruiser. All openings at this point were filled with concrete before compressed air was admitted into the flooded areas.
Right—Beaching the "Moltke" on the shore of Cava Island.

who was the brains of the undertaking and who carried it to a successful conclusion. He showed that the age of romance in engineering is not a thing of the past, and that there are still plenty of opportunities for the man of vision.

Just when the stupendous task of raising the German fleet from the depths of the sea first occurred to Mr. Cox is not known, but it probably was the outcome of the purchase by Mr. Cox of the submergible testing dock from the British Government. Mr. Cox was accustomed to dealing with big things; and after having acquired that item of equipment it was only natural that he should ask himself: "What can I do with it?" The logical answer that in all likelihood flashed through his mind was: "Use it in refloating the German fleet lying on the sea bottom off the Orkneys."

The towing of the submergible dock to Scapa Flow signaled the beginning of operations. On reaching there, the dock was cut in two and each half equipped with numerous 10-ton winches provided with strong steel cables passing over 4-foot pulleys. With these winches it was possible for the wreckers to exert a 2,000-ton lift on the lines and literally to raise the destroyers, one by one, after divers had passed a number of the cables beneath each vessel and connected them to the winches on the dock sections brought into position on either side of the sunken ship. Slung in this fashion, the craft were successively carried to the shore—the lines being shortened with decreasing depth.

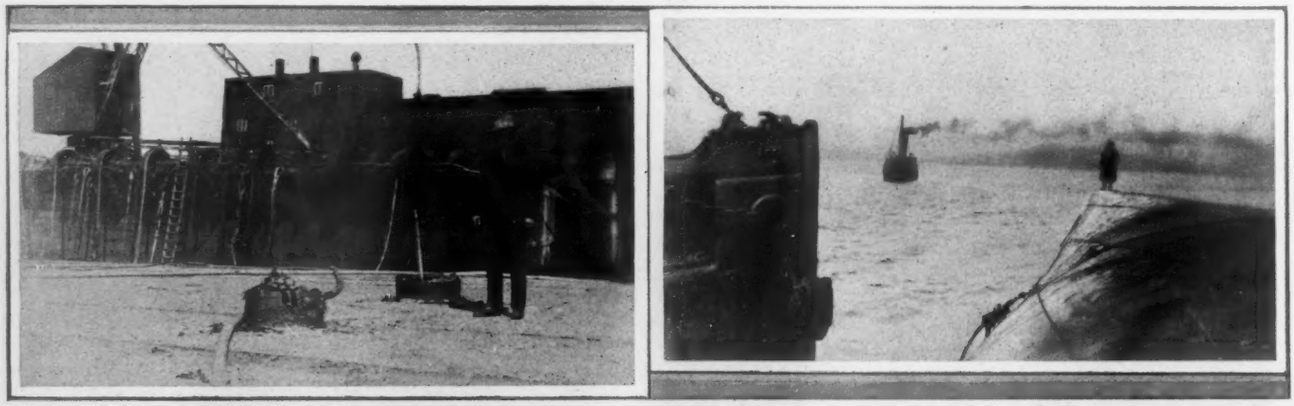
Told in these few words, and stripped of all elaborating details, the task of raising the destroyers sounds like a fairly simple operation. But when one considers the exposed position, the continually heaving seas, the recurring storms, and the altering levels at which the work had to be done, then the full significance of the nature of the undertaking becomes more apparent. At times the weather was so severe that the cables snapped like threads after weary hours spent in putting them in place and making them fast. During one especially stormy period, twenty of the lines used for lifting were thus parted.

Compared with the magnitude of the work involved in handling the battle cruiser *Moltke*, the raising of the twenty-five 1,000-ton destroyers was an easy proposition. But, just the same, it was no small accomplishment, as the man of experience knows how enormous are the forces that must be juggled with and overcome in salvaging craft of even this relatively small displacement.

The *Moltke* lay on the sea bed off the western shore of Cava Island where the water is 72 feet deep. She had a list of 16½ degrees to port and her bow was considerably higher than her stern. The ship is 610 feet long, has a beam of 96¾ feet, and draws 28 feet of water on a displacement of 23,000 tons. The dead weight that had to be handled in refloating the vessel can be more easily visualized if we say that her vitals were safeguarded with armor plate ranging in thickness from 4 inches to 11 inches. This armor plate sheltered her water line, her main and secondary batteries, the bases of her smokestacks, and two decks purposely placed so as to keep plunging shell from reaching her boilers, engines, and magazines. The day the *Moltke* was sunk she carried ten 11-inch guns, twelve 6-inch rapid-fire rifles, and twelve 24-pounder guns. She was also equipped with four submerged tubes capable of launching 20-inch torpedoes. Her turbines could develop a total of 70,000 s.hp. actuating four propellers; and at full speed the craft was able to make 27 knots an hour.

When the German crew flooded the *Moltke*, the craft capsized and came to rest on the bottom in a position that added measurably to the difficulties of the salvage work. Her masts and funnels were broken off, but they were still attached to the hull by their stays and gear; the bridge on the port side was crushed beneath the weight of the overlying mass; and her gun turrets were damaged. Before actual operations could be begun it was first of all necessary to remove some of the entanglements so that the divers would not be needlessly hampered in their underwater work which, at its best, is extremely hazardous.

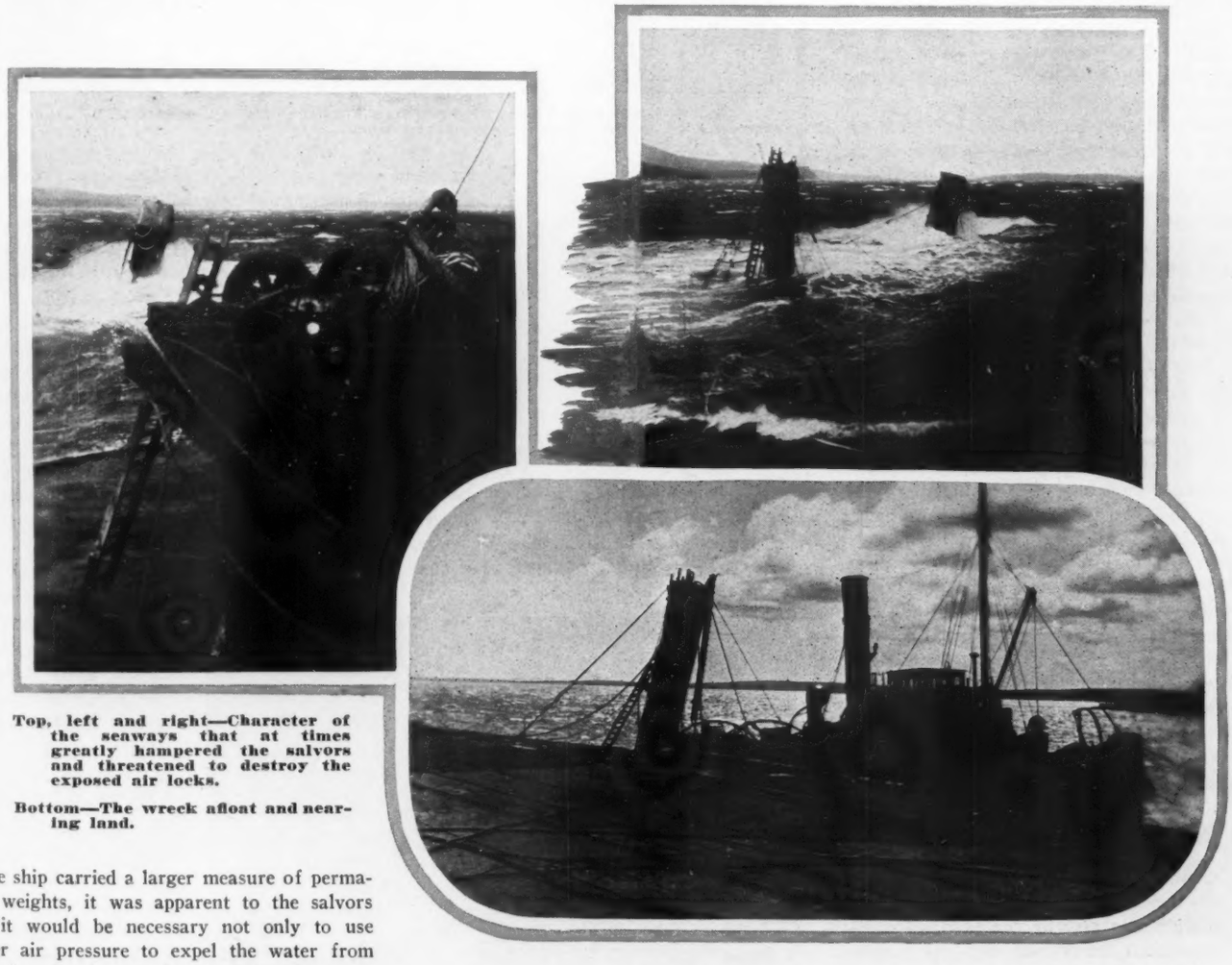
The plan was to right the cruiser and to bring her to the surface by the use of compressed air. This meant making the hull watertight. As a preliminary step towards this end, the various watertight bulkheads in the craft had to be located. An air lock was therefore constructed in the neighborhood of the ship's bow which, as previously explained, lay considerably higher than the stern and



Left—How the holes in the submerged hull were made watertight with plugs of concrete.
Right—Getting ready to beach the "Moltke."

could thus be reached at low tide. This air lock gave access to the *Moltke* at a point about 50 feet forward of the boiler-room bulkhead, and this distance had to be traveled by the divers in going to and from that compartment. As the craft was inverted, the divers, of course, had to walk upon the ceilings instead of the decks; and, to make matters worse, barnacles had accumulated upon many of the submerged interior surfaces—the sharp edges of these marine creatures cutting the bared hands of the underwater toilers.

Owing to the fact that the stern of the *Moltke* lay at a greater depth than the submerged bow, and also because the after body of the ship carried a larger measure of permanent weights, it was apparent to the salvors that it would be necessary not only to use higher air pressure to expel the water from those inundated areas but to force the water downward and outward to a lower level in order to obtain the buoyancy required to lift the load involved. Therefore, an additional air lock was installed at a point aft where entrance could be effected into the engine room. Some of our illustrations show the type of air locks employed; and these were of ample length to reach from the submerged hull to well above the surface at low tide. The pictures also indicate the character of the seaways that the air locks were exposed to in stormy weather.



Top, left and right—Character of the seaways that at times greatly hampered the salvors and threatened to destroy the exposed air locks.

Bottom—The wreck afloat and nearing land.

Manifestly, because of the sloping sea bed upon which the *Moltke* rested, the raising of the bow, with the stern still without buoyancy, would have tended to depress the stern still further and to force it perhaps deeper into the water bed. Accordingly, other means than compressed air had to be utilized to insure a uniform lifting effort forward and aft. To this end, the submergible dock, which had been used successfully in raising the sunken destroyers, was again brought into service. One section of this dock was placed alongside and above the wreck, and 24 steel cables, secured to it, were passed down and around one of the turrets and also attached to other points. These lines were hauled taut at low water; and as the tide rose the buoyancy of the dock exerted a combined lifting and turning moment of 2,400 tons. At the same time, compressed air was forced into certain of the after compartments to expel the sea water and to impart a large measure of internal buoyancy. It will be realized that the cables, required to right and to raise a mammoth structure such as the 23,000-ton sunken and inverted battle cruiser, would necessarily have to be of large size and of great strength. The 24 steel cables just referred to were 9 inches in diameter; but, even so, a number of them parted when subjected to the stresses developed.

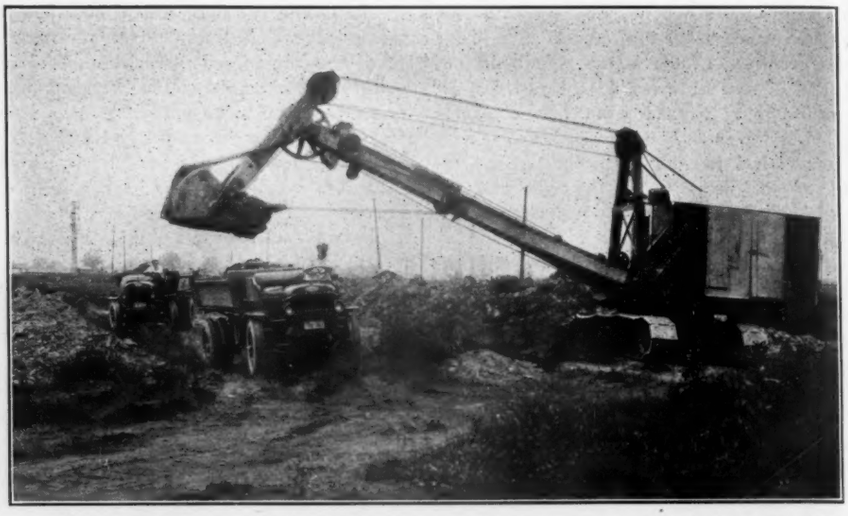
Despite the strenuous efforts of the divers, there were various places within the ship where bulkheads could not be made absolutely tight. When compressed air was applied at lower points—and naturally at a higher pressure to effect the expulsion of water—some of the air worked upward through these openings and accumulated in the peak at the foremost section of the craft. This air, being of higher pressure, tended to evacuate the water there and to increase to a troublesome extent the buoyancy of the bow. To neutralize this, a relief valve was fitted that would permit of the control of this intrusive air so that the buoyancy could be regulated as desired. It might be mentioned here that the decks were made water-tight by filling up all openings with concrete.

When the after part of the vessel had been made sufficiently airtight and the second air lock had been installed, then it was possible to expel water from the flooded area. However, the leverage at the bow was still such that the list to port could not be overcome. This puzzling situation was attacked in the following resourceful manner. Half of one of the refloated destroyers was secured to the starboard bow of the *Moltke*. This additional weight of 300 tons of metal and 200 tons of water was counted upon to exert a depressing and turning moment that would act in the same

direction as that obtained through the cables attached to the floating submergible dock. Notwithstanding this combination of efforts, the list to port persisted; and a third means of increasing the turning moment was resorted to —that is to say, the tanks and the bunkers in the wings or at the sides of the ship were made airtight, after which the subdivisions on the port side were filled with buoyant air while the corresponding subdivisions on the starboard side were kept flooded with 1,000 tons of water. Next, a pontoon—consisting of one section of the submergible dock—was moved to the starboard side of the *Moltke*, forward, and twelve cables were passed from this pontoon over the interposed destroyer and thence down underwater where they were fastened to the edge of the deck on the port side. When the tanks of the dock section were charged with water, this increased dead weight exerted a corresponding pull tending to raise the port side and to depress the starboard side in an effort to overcome the troublesome list. In the end, this provision proved to be superfluous, because the 2,400-ton pull of the other section of the dock, the 500 tons of dead weight of the half of the destroyer, and the 1,000 tons of righting effort exerted by the air and the water in opposite tanks and bunkers, finally brought into play the needful turning moment or force.

Before the ship was freed from her resting place and brought to the surface, many difficulties were encountered, but each in its turn was overcome. The movement of compressed air within the craft was hard to control—that is, the air had a tendency to escape and to exert buoyancy at points where it hampered the salvors; and parts of the cruiser—such as turrets and other projecting structural features—were deeply embedded in the sea bottom. When the list of the cruiser was substantially corrected it was possible to withdraw the dead weight of the destroyer section; but as soon as this was done the bow rose above water. The relief valve provided for just such a contingency was opened, and the output of the whole battery of air compressors was directed to the interior of the after body of the craft. As a consequence, and to some extent unexpectedly, the stern emerged and exposed the bottom of the vessel coated with great masses of marine growth—an accumulation of eight years. Thus, after months of preparation, that ponderous bulk was refloated mainly through the buoyancy brought into play by confined and carefully distributed compressed air. As a precautionary measure, the compressor plant was such that, even in the event of its breakdown, sufficient air would have been available to enable all the men to escape from the ship before the compartments could again have been flooded.

When the stern appeared above the surface, the confined air within the ship shifted to a considerable extent from the bow to the stern, so that the bow promptly became the lower portion of the vessel—thus reversing its previous position. Nevertheless, this posture of the giant cruiser was not a troublesome one, in fact the salvors could move about easier within the ship and close, as needed, any of the holes or passages by which the air could be shifted from end to end of the *Moltke*. With the vessel floating, even though upside down, the next operation was to tow the wreck to the beach where it could be stranded preparatory to breaking it up. Despite storms, troublesome currents, and hampering tides, the work was carried on to a successful conclusion, and the great hulk was grounded on the shore of Cava Island.



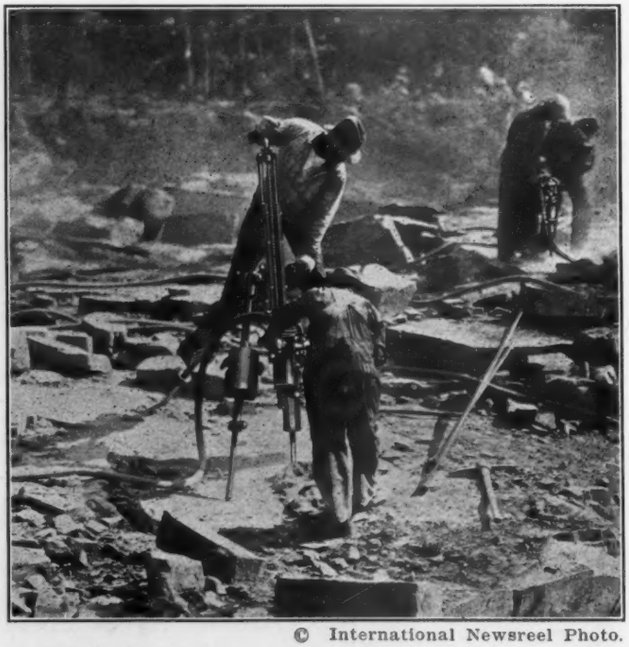
This "back digger," built by The Thew Shovel Company, is said to be especially effective in sewer and other excavating work.

"BACK DIGGER" A NEW TYPE OF STEAM SHOVEL

THE Thew Shovel Company has placed on the market a new type of pull shovel or trench hoe designed to facilitate sewer and excavating work. It differs from previous machines in that the bucket can be tilted by the operator at any angle desired and during any stage of the digging or dumping. In other words, he can hold the bucket or change its position at will.

This feature is said to prevent spilling of the dipper load throughout the entire arc of the digging arm, and to permit the operator to hold his load until he has spotted his dipper at just the right place, after which it can be instantly dumped. In close dumping, it is unnecessary each time to swing the dipper to the extreme limit in order to empty it completely. The operator can also shake the dipper to dislodge sticky material.

The new shovel makes it possible to control the angle of the dipper teeth at any position of the digging arm. This feature is of advantage in general digging, and enables trimming the sides and the bottom in basement digging. The tilting dipper is likewise especially suitable for back filling. The Thew Company calls the new product a "back digger." The special equipment can be attached to other types of Thew machines already in service.



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Air-driven drills at work on the rocky site, on the New Jersey side of the Hudson, of the great bridge that will span the river from Fort Lee to Fort Washington. This will be the first bridge linking New York with New Jersey across the lower part of the Hudson River where ships with towering masts pass in large numbers.

The production of synthetic lumber from sugar-cane refuse is engaging the attention of Hawaiian sugar growers. The profitable utilization of this by-product would add considerably to the revenue of the growers.

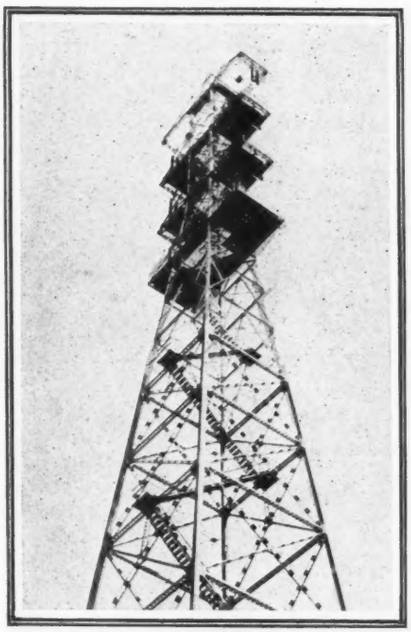
Cleaning and Painting Transmission Towers With Compressed Air

By CHARLES W. GEIGER

THE superiority of the pneumatic methods of cleaning and painting high, steel transmission-line towers has been demonstrated in California by the Pacific Gas & Electric Company. Not only is less labor required, but there is also a notable improvement in the quality of the work as compared with that done by manual effort. This is so pronounced that, it is believed, repainting will now be necessary only once every ten years instead of every five years, as is the case when the paint is applied by hand.

The towers in question are lofty steel skeletons that carry the power lines across rivers. Their character is such that cleaning and painting operations involve steeple-jack tactics. Their maintenance is a costly undertaking, at the best, and for that reason any betterment in method is especially welcome. The company concerned recently set out to repaint approximately 100 of these river-crossing structures at various points in its transmission lines. The highest of these is a group near Antioch, where the wires span the Sacramento and the San Joaquin rivers. To insure sufficient clearance for river craft under the lower cables, there are five towers that have respective heights of 269, 314, 359, 410, and 460 feet above their foundations. The last-mentioned is reputed to be the highest structure of its kind in existence, and contains 404,500 pounds of structural steel.

Where long spans were involved, high anchor towers were built at each end of the river section, with a suitable number of suspension towers of lesser height between them. At the crossing of the San Joaquin River, the total distance between anchor towers is 8,835 feet, with three interposed suspension towers to support the wires. The Sacramento River is bridged by means of anchor towers 8,030 feet apart and two intermediate suspension towers. This section contains the longest single span in the system—4,135 feet. The upper portions of all these towers are identical. As the lower parts are battered, the higher the tower the greater the area covered by its base. Each of the four corners rests on a concrete foundation.

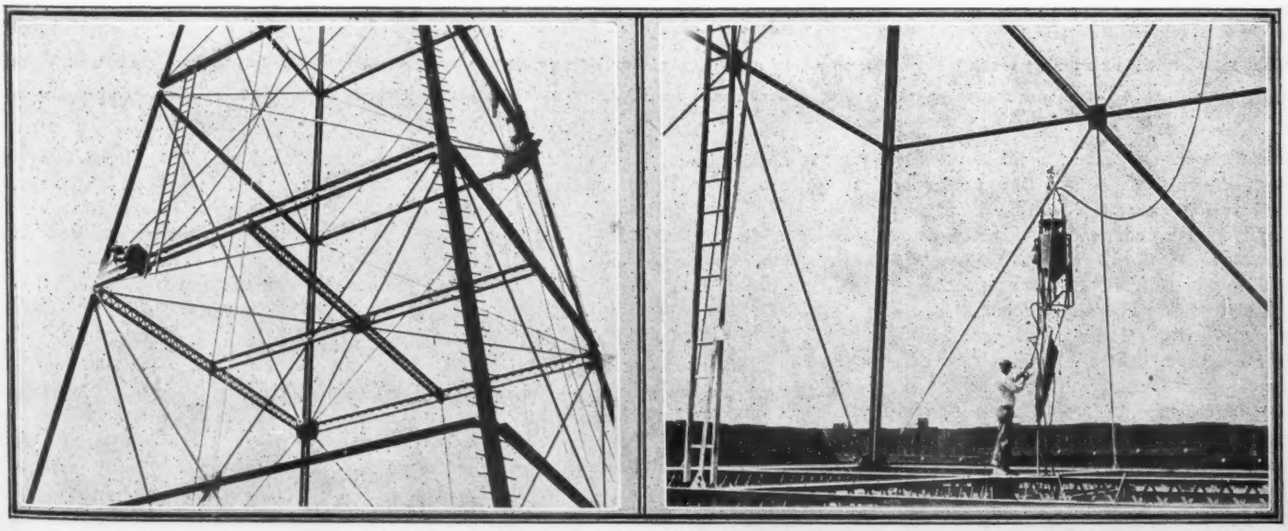


Stairways and platforms in the tops of some of the towers lessen the hazards to which the men are exposed in sand blasting and repainting these structures.

These fabricated structures are continually exposed to the weather in a region of frequent fogs that promote rust and corrosion. Therefore, it is essential that all portions of their rather intricate framework be kept protected by a film of paint if the towers are to stand up under the great strain placed upon them by the heavy cables and conductors and by the high winds that sometimes prevail. Prior to repainting, all surfaces must be thoroughly cleaned. Until recently, hand methods have been employed by power companies the world over for this important maintenance work. Wire brushes were commonly used to remove the old paint and rust; and the new coating was applied by brush in the regular manner. About eighteen months ago the Pacific Gas & Electric Company enlisted the aid of compressed air in the performance of these tasks, and the management found it so satisfactory that pneumatic methods were adopted as standard practice.

The cleaning is done by sand blasting, which effectually removes paint and rust from points not accessible to hand workmen. In like manner, paint that is sprayed by a jet of air penetrates corners and joints that cannot be reached by brush. Both operations can be accomplished at a lesser cost for labor than under the older methods. The cleaning and painting of the 460-foot tower near Antioch was completed by a crew of five men and a foreman in six weeks.

Work is started at the top of a tower, where



Left—Sand-blast operator at work on a section of the steel skeleton. Near him may be seen the movable ladder on which he climbs about.
Right—A sand-blast drum and some planks, to be used as a platform, about to be raised aloft by means of an air hoist.

three steel platforms at different levels are incorporated in the construction. Electric current is turned off while these upper portions are being treated. The workmen then move downward, completing a section of approximately 30 feet before passing on to the next one. Some of the towers have steel steps leading up to the top, which greatly facilitate the movements of the men. Others have ladderways up one corner, and still another type has latticework members that can be climbed. Where these structural features are lacking, ladders with curved ends that hook over a cross piece in the framework are employed.

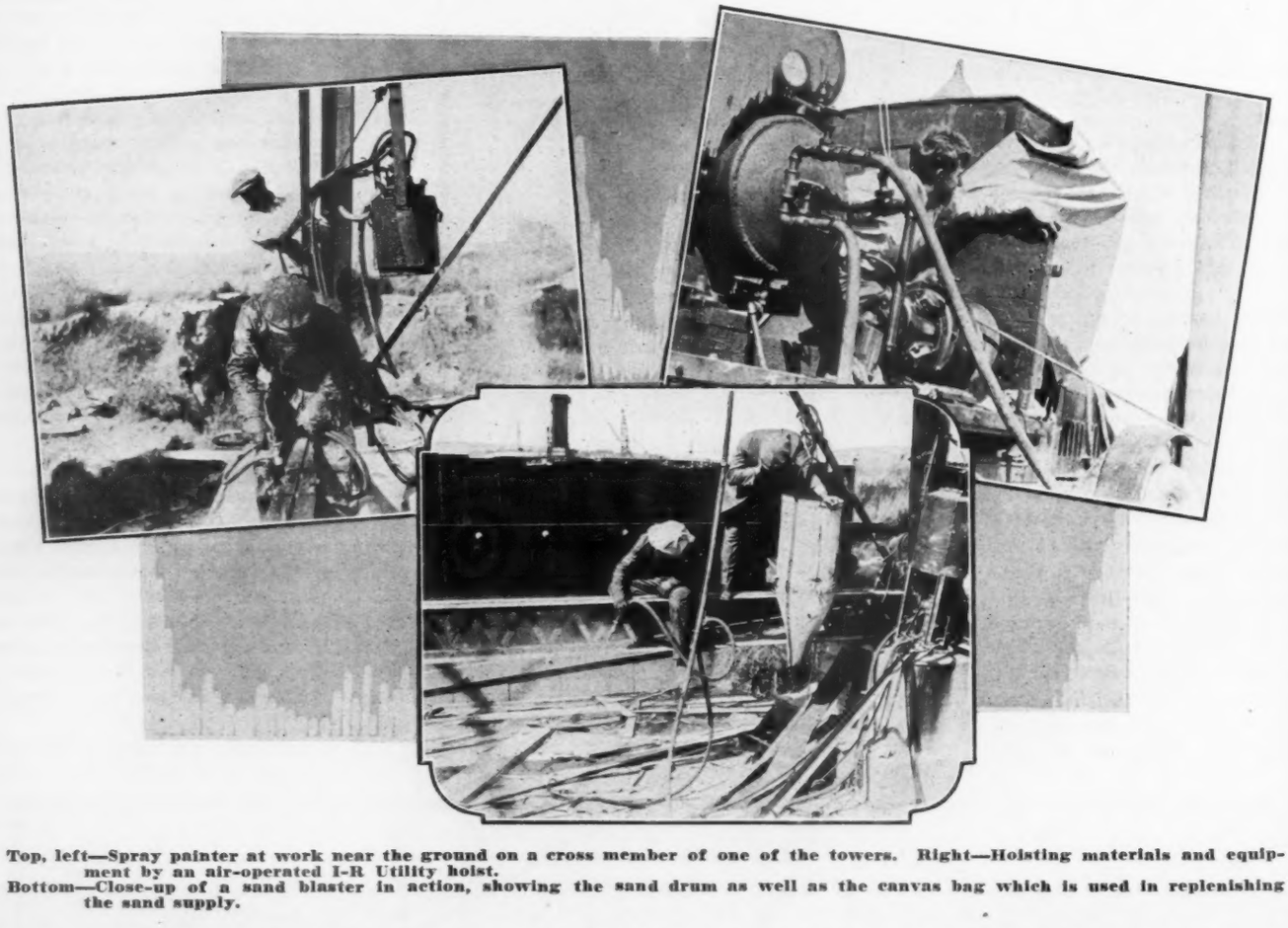
Ordinary sand-blasting and spray-painting equipment are used. The practice is to lay planks upon two cross members in one corner of the tower to serve as a platform for the sand drum and the paint container. These apparatus are elevated by means of an air-operated Ingersoll-Rand utility hoist, which is mounted on a motor truck. The sand drum has a capacity of 300 pounds. The supply is replenished, as needed, by hoisting it in a canvas bag. This bag has a funnel-like bottom through which the sand can be run directly into the drum.

A 50-foot length of hose leads from the sand drum to the operator. Near the nozzle end the hose is fitted with a hook for fastening to the operator's belt, thus leaving both his hands free for climbing about. Each workman wears a safety belt, which is provided at the hips with rings to which are attached steel harness snaps and a steel cable so devised that it can be made fast to a tower member. This arrangement prevents the worker from falling in case he should lose his footing.

After a 30-foot section has been sand blasted, the spray painter begins operations. He is able to paint as much surface in three hours as the sand blasters can cover in a day. When he has finished he joins the sand-blast workers until another section has been made ready for painting. Great care is taken to paint any surface the same day that it is sand blasted, because in foggy weather oxidation sets in within 24 hours. A second coat of paint is applied by two men, working from the top downward. In order to make the equipment as flexible as possible, two complete sand-blasting outfits and two complete paint-spraying outfits are furnished, thus permitting all operators to keep busy all the time.

Since dry air is required for satisfactory sand blasting, a suitable device is provided at the foot of the tower to condense and to drain off moisture in the air line. The air then passes on to a manifold from which hose connections can be made, as desired, to serve the various sand-blast drums and paint receptacles.

As a base of operations for work on these river-crossing towers, the company maintains a barge which houses the necessary equipment and which has living quarters to accommodate the workmen. It is towed from tower to tower by tugboat.



Top, left—Spray painter at work near the ground on a cross member of one of the towers. Right—Hoisting materials and equipment by an air-operated I-R Utility hoist.
Bottom—Close-up of a sand blaster in action, showing the sand drum as well as the canvas bag which is used in replenishing the sand supply.

INSTRUMENT THAT MEASURES BILLIONTH OF AN INCH

AN instrument so delicate that it will measure a billionth of an inch has been devised in the Bell Telephone Laboratories so as to enable the research experts to continue certain investigational work with magnetic materials that play so important a part in all forms of electrical communication.

In magnetizing a metal, we learn from the *Journal of the American Institute of Electrical Engineers*, a loss is ordinarily suffered which evidences itself as heat. This varies for different alloys; and, because of a lack of definite information on the subject, it was believed that the loss was closely connected with the change in length. To determine this, it was necessary to have a measuring instrument of greater refinement than any in existence.

The instrument, developed by P. P. Cioffi, measures changes in length of a piece of wire about 4 inches long. To keep the temperature of the wire constant—a necessary precaution, the wire is surrounded by a vacuum cylinder, like a thermos bottle, with an opening at each end. In addition, a special electrical compensating coil is used. The entire equipment is mounted on a spring suspension so that it will not be affected by vibrations.

Compressed Air In An Automobile Plant

Pneumatic Tools and Machines Are Indispensable To The Fabrication of Star Cars at Elizabeth, N. J.

By C. H. VIVIAN

ONLY a few years ago, a person who placed an order for a new automobile expected to wait some time to secure delivery. The reason for this was that factories were unable to keep pace with sales: the industry grew so fast that the production end suffered from growing pains.

Conditions are largely different today. They have changed because factory facilities have been greatly augmented, and also because rapid strides have been made in the development of better and more adequate plant practices. The outgrowth of these extensive improvements is a system of manufacturing on a quantity basis that is one of the marvels of the times. This volume-production idea, which has been worked out to a nicety by the big automobile concerns, is still the object of intensive study by plant engineers. The highly competitive nature of the automobile business demands that a manufacturer, if he is to survive, must keep his plant at least as efficient as those of his rivals. Any gains that he can make by bettering his methods of output will react to his advantage. Consequently, every step in the process of building cars is under close scrutiny at all times with a view to devising ways and means to save another minute or two here or another cent or two there.

This system, that has made it practicable to build motor cars at a truly amazing rate of speed, is not the result of some magical discovery or formula. It consists merely of dividing up the complicated process into innumerable individual and simple operations and of delegating specific tasks to the same workmen. Furthermore, each worker remains at an assigned station with the necessary tools close by. The arrangement, which has made possible this scheme of erection, is known as the assembly line.

THE building of modern motor cars involves a multiplicity of operations. To accomplish these in the most effective and economical manner, automotive engineers have developed an industrial marvel in the form of the assembly line.

Each of the hundreds of workmen in an assembly plant performs one or more specific tasks. The variable factor of human labor has, however, been largely eliminated by the extensive application of mechanical appliances to the work in hand. This makes for a standardized product and insures a high quality of workmanship on every car.

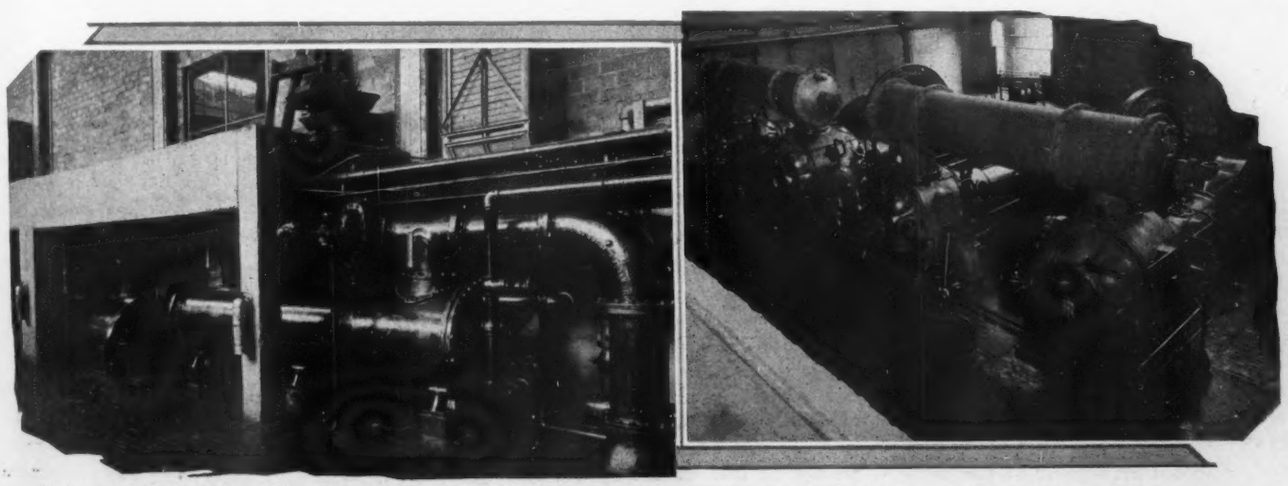
Most of the tools employed are operated by compressed air, which therefore assumes a place of importance in automobile plants. Some idea of the manifold and diverse uses of this flexible and convenient form of power may be obtained from the accompanying article descriptive of the methods that prevail at the Elizabeth, N. J., factory of Durant Motors, Inc.

As each assembly line will turn out a certain number of finished cars per day, the total production of a plant can be increased, as desired, by providing more assembly lines. Each line, then, is a unit of production, and can be standardized. This means that a manufacturer may produce or buy the individual parts required for his make of car and bring them together in any one of several assembly plants strategically situated throughout the country in relation to the markets for the finished product. This insures speedy delivery to sales agencies in all communities by reason of relatively short rail hauls.

Volume production not only has progressively lowered the retail selling costs of automobiles but has actually given the public better cars. The division of labor is such that each workman performs only a few operations—sometimes but one. It follows that he becomes expert at his work; and inasmuch as the finished car represents the combined efforts of himself and others of his kind, it is, in truth, the product of specialists. The continually increasing mechanization of plants and the steady improving of the machinery already in use likewise contribute to the general efficiency. All in all, the motor car, regardless of price, is becoming more and more a precision product.

Compressed air has always had a notable part in the building of automobiles, and with the advances that have come about in plant operating practices that motive medium has grown in importance until today it is wellnigh indispensable to the industry. This relation of compressed air to the fabrication of the efficient and attractive automobile of the present day is summarized in a clear manner by Mr. C. L. Allen, plant engineer of the Elizabeth, N. J., factory of Durant Motors, Inc. This is the largest of the four plants maintained in this country and in Canada for the assembly of Star motor cars. Mr. Allen says:

"It would be utterly impossible to produce



Left—Type HK aftercooler, through which the air passes after leaving the compressors.
Right—These PRE-2 compressors supply the air that plays such an important part in the building of Star automobiles.

automobiles at their present selling prices without the aid of compressed air. Not only does it enter largely into the making of the various parts, but it also plays a leading *rôle* in bringing together those parts to form the completed cars. It is safe to say that in the assembly of Star automobiles in our plant here, compressed air has some part in 90 per cent. of the operations involved. There are few machines or tools used that do not employ it as their motive power.

"Pneumatic devices simplify and speed up the work at every point along the assembly line, thus aiding materially in maintaining production schedules. Furthermore, they insure better workmanship, because a given operation is performed in the same thorough manner on every car. A man who turns a nut on a bolt by hand all day long will of necessity, from time to time, vary the force he exerts, but the air-driven tool that performs this or any other function will not deviate from a fixed standard of execution. Two or more men working at like tasks will not produce equal results, but two machines, or a hundred machines, will do indistinguishable work.

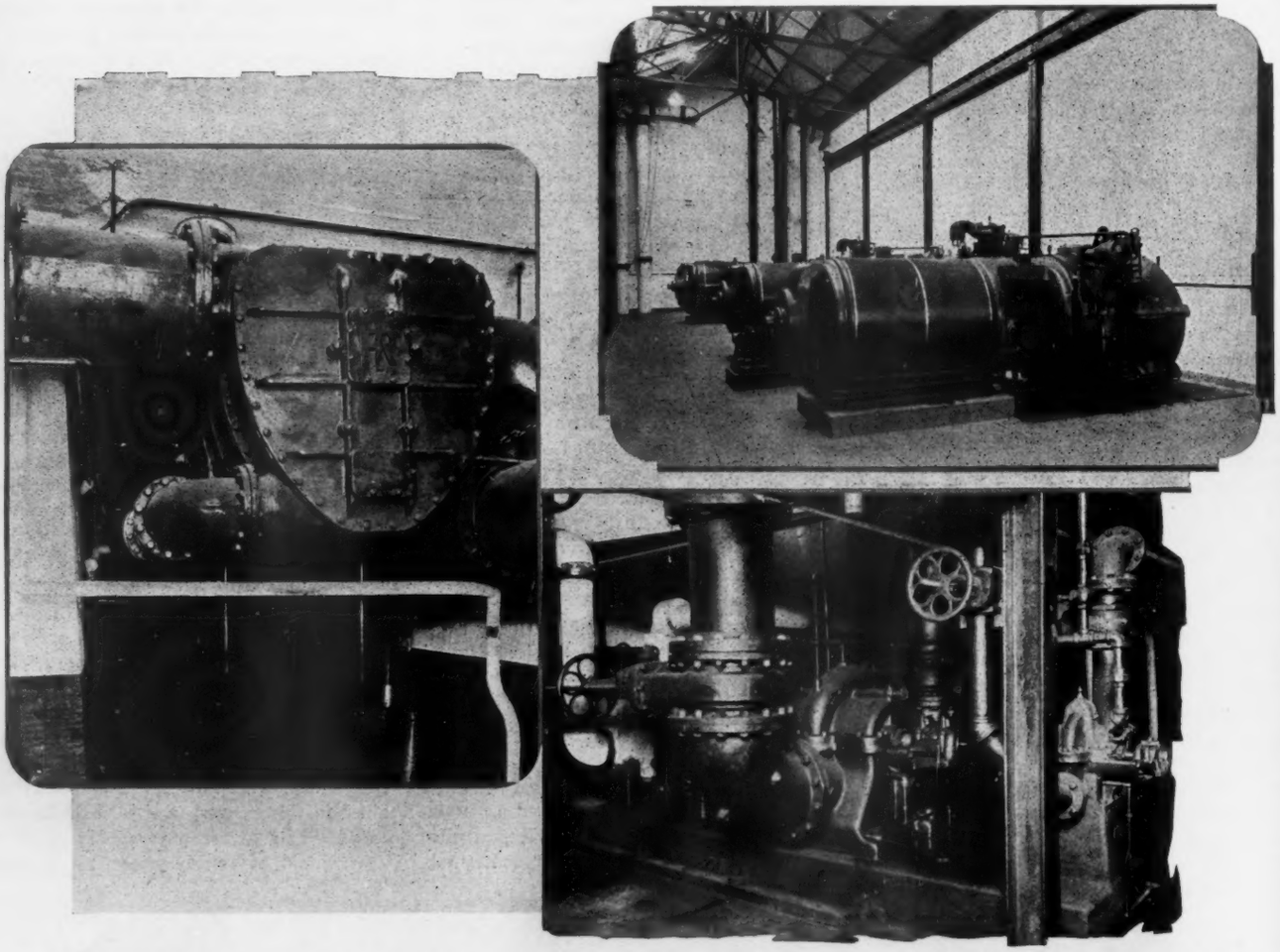
"The widespread employment of compressed air in our plant is a guaranty to the buyer of a Star car that he is getting a product that is the result of the most modern and the most thorough assembly-plant practice. If we were making the most expensive automobiles obtainable, we could not exercise more care or greater precautions in putting them together."

A trip through the plant cannot fail to impress the visitor with the significance of Mr. Allen's statement. From the forming of the main frame, or chassis, to the driving of the finished car off the assembly line, the contributing operations are characterized by a fine coördination and synchronization of efforts, by striking dexterity on the part of the workmen, by a highly developed dovetailing of each operation with those that precede and follow it, and by a perfect articulation of each department with the others.

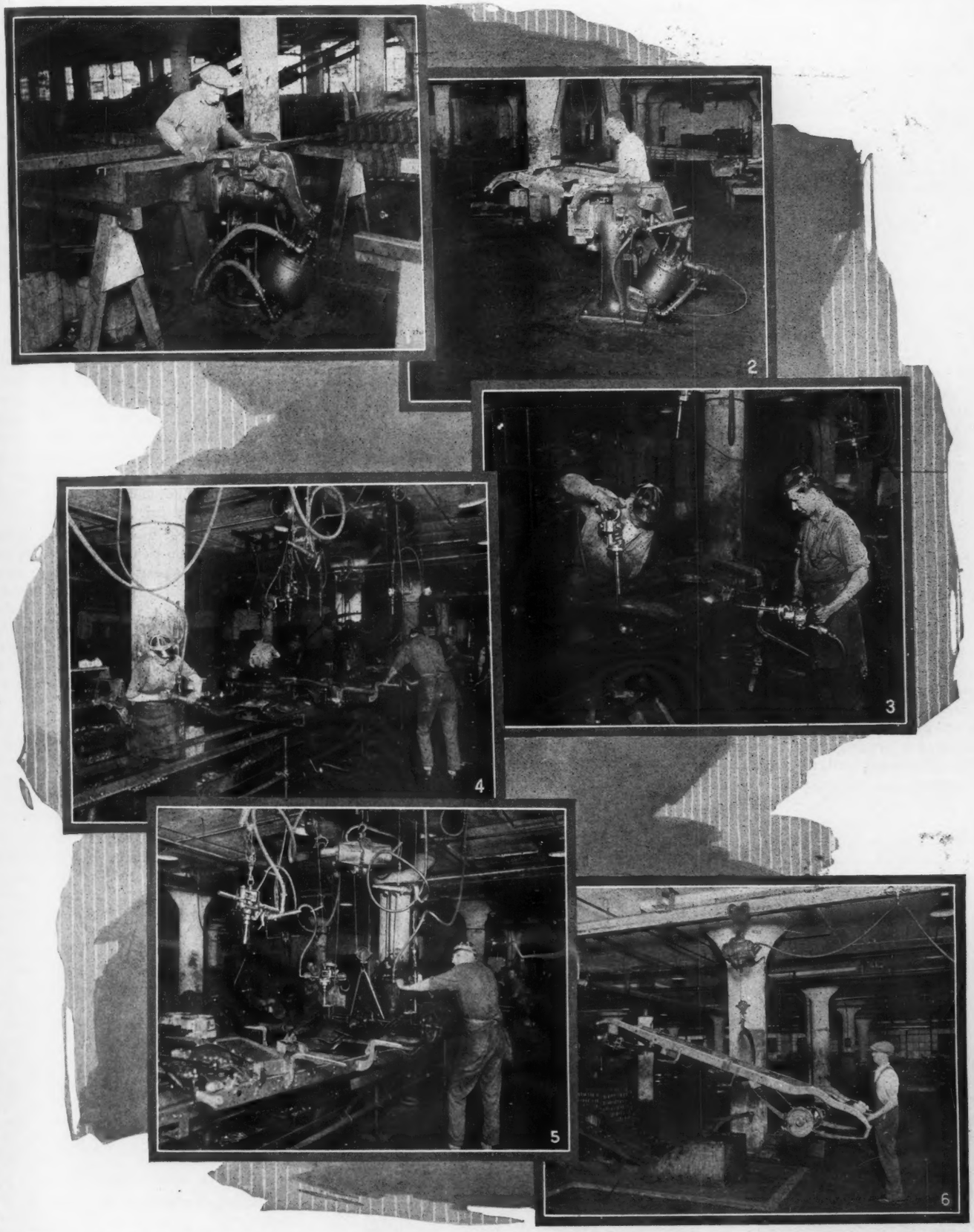
There is surprisingly little manual labor, and none of it is arduous. The heavy work is all done by machines. Man's chief function is to guide and to control these outlets for mechanical force. In the light of what has been said, it is hardly necessary to repeat that most of the labor-saving and labor-lightening devices are actuated pneumatically. Without an attempt at detailed description, some of the more important uses of compressed air will be pointed out. First, however, it might perhaps be well to present a few general facts regarding the plant in order that the magnitude of the operations may be appreciated.

The Elizabeth plant of Durant Motors, Inc., has complete facilities for the assembly of Star automobiles. It also houses the factory of the Hayes-Hunt Corporation which makes the bodies for all Durant closed-car models whether they are assembled at Elizabeth or at one or the other of the plants maintained at Lansing, Mich., Oakland, Calif., and Toronto, Canada. Well-lighted and conveniently arranged buildings of modern construction rise to a height of four stories on a plot of grou measuring 1,800x750 feet and covering 2 acres. The floor space aggregates 2,098,7 square feet. The plant is served by 18,350 f of railway tracks with sidings capable of a commodating 310 freight cars. The facto provides employment for from 2,500 to 3,0 persons, the number varying according to t production schedule.

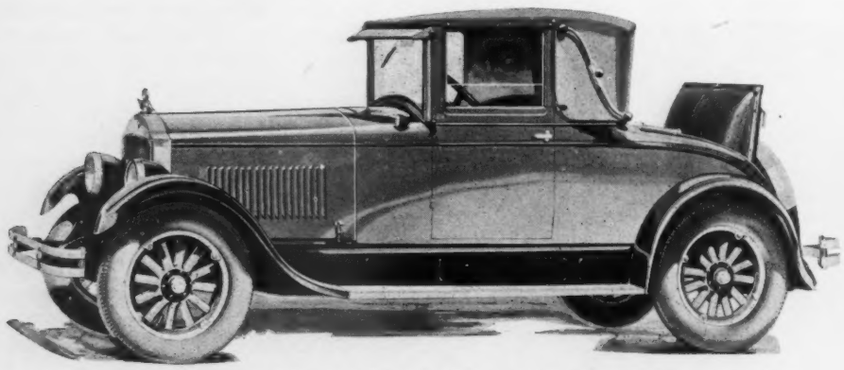
Because compressed air is so vital to t building of automobiles, every effort has be made to furnish air-producing equipment th is thoroughly dependable and economical a that will function with a minimum amount



Top—The three turbo-generators that furnish power for the Elizabeth branch of Durant Motors, Inc. These generators have a combined capacity of 7,500 kw. and are equipped with Ingersoll-Rand condensers, one of which is shown at the left.
Bottom—One of the Cameron combination pumps that serve the condensers.



1—The first step in fabricating a Star chassis. Riveting support brackets to a side member of the frame.
2—The cross members of the chassis are put in place by riveting.
3—The splash pans are quickly attached to the chassis by running up nuts on the bolts with No. 6 air drills.
4—Driving shackle bolts with compressed air. The maze of pneumatic tools suspended overhead gives an idea of the extensive use to which they are put in this plant.
5—Bolting on the rear-axle assembly with air-driven tools.
6—An air hoist transports the chassis, with its springs and axles in place, to the main assembly line.



One of the finished models. A Star 6-cylinder cabriolet with collapsible top.

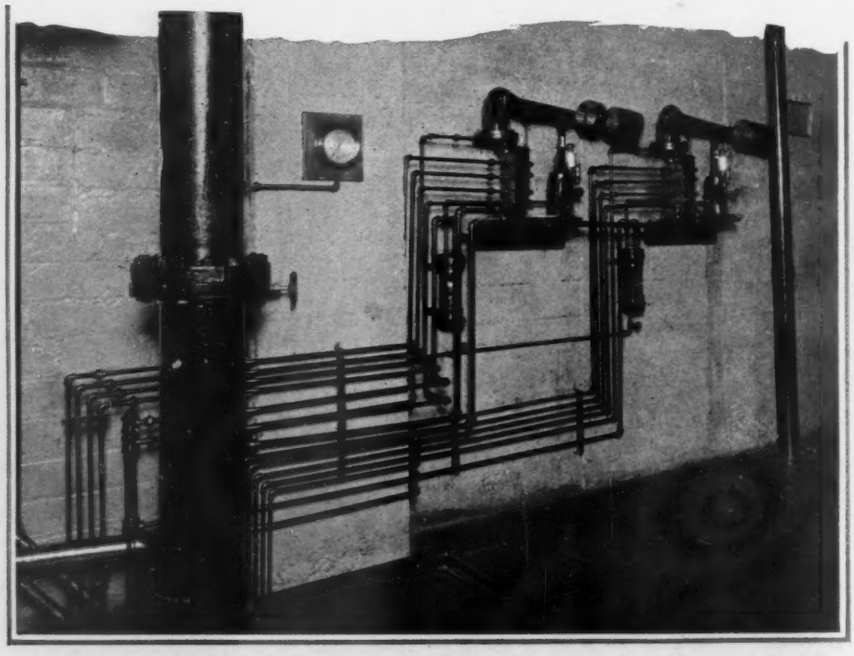
attention. The installation consists of two Ingersoll-Rand PRE-2, 37&23x27 units, each of which is directly connected to a General Electric 820-hp., synchronous motor which operates at 150 revolutions per minute. This type of compressor uses the patented 5-step clearance control which automatically regulates the output capacity at full, three-quarter, one-half, one-quarter, or no load, according to the demands being made on the air lines. Ordinarily each compressor has its regulator mounted upon it, but at the Durant plant remote control is provided by placing the regulators for both machines side by side at a convenient point in the compressor room.

After being compressed, the air passes through a large, horizontal aftercooler of the HK type and then enters a suitable air receiver. At the time the plant was visited, the gage on the outlet line from this receiver showed the pressure to be 106 pounds. For practically all purposes the air is used at 100 pounds pressure, and that pressure is maintained on the line at points 1,800 feet away from the compressors.

The compressors and the auxiliary equipment were erected under the supervision of Mr. Allen, who planned an installation of such capacity that one machine ordinarily supplies all the air required—running at full load most of the time. When the demand becomes too great for one unit then the second unit is started and operated as long as is necessary. One machine is in continuous service for 24 hours—the two units being alternated, day by day. Both compressors were obtained during 1926.

The plant has its own sources of power. There are three General Electric turbo-generators having a combined capacity of 7,000 kw. One is of the high-pressure type and has a steam consumption of 45,000 pounds per hour. Its rating is 3,000 kw. Each of the other two is rated at 2,000 kw., is of the mixed-pressure type, and consumes 40,000 pounds of steam per hour. All three units are served by Ingersoll-Rand surface condensers and Cameron double-suction centrifugal pumps.

The water supply is derived from four wells on the property, each of which is 800 feet deep; and the pumping is done by means of air lifts. The normal water consumption of the plant is 15,000,000 gallons per month. The main storage tank has a capacity of 500,000 gallons. There are two sprinkler tanks of 50,000 gallons capacity each and one of 100,000 gallons. A 50,000-gallon house tank takes care of the water for lavatories and for other general purposes throughout the establishment.



These controls automatically regulate the 5-stage clearance pockets which are a feature of the Type PRE-2 compressor.

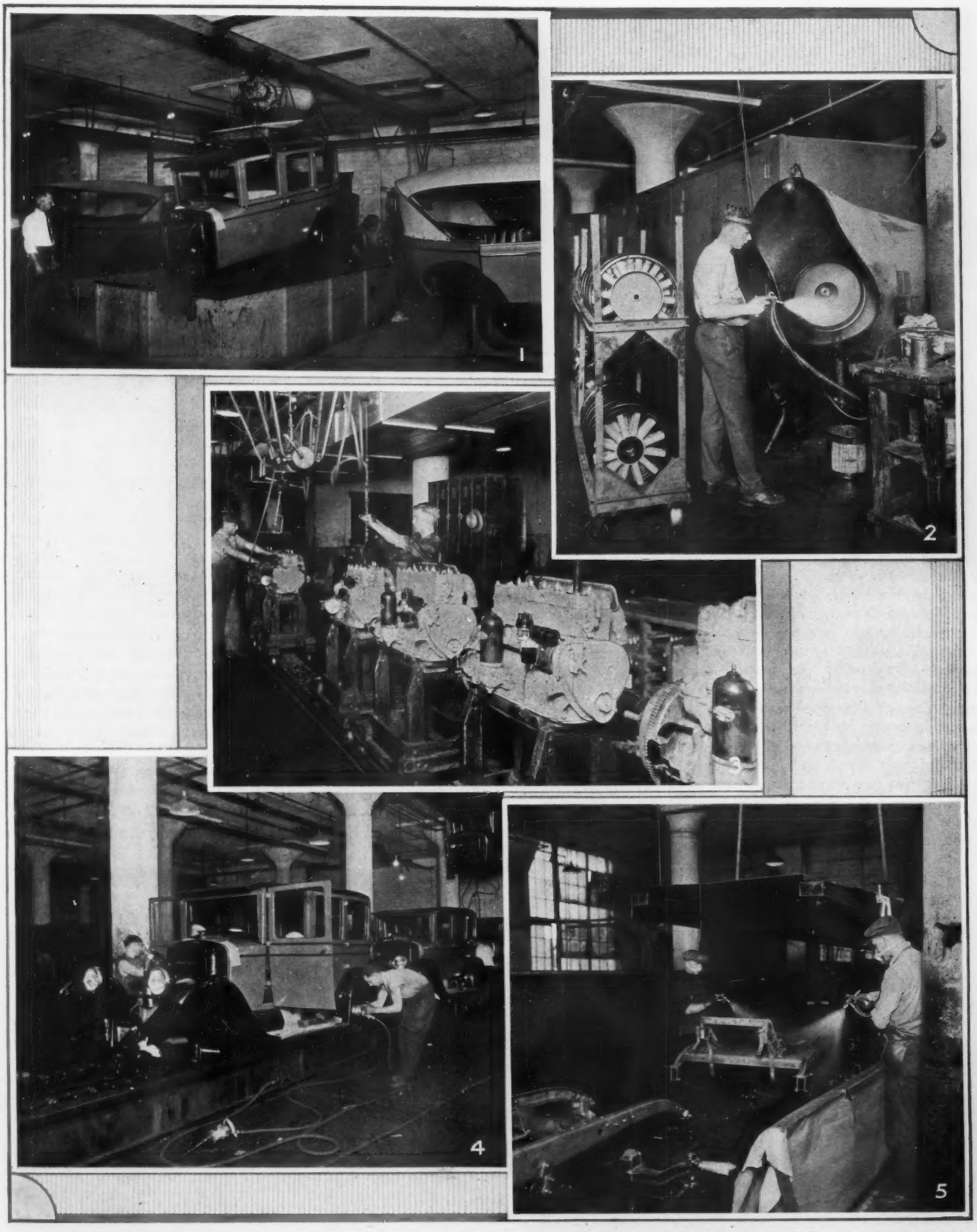
Three main assembly lines are provided having a combined capacity of 900 cars per day. From end to end one of these assembly lines is 820 feet long. The chassis are carried this distance by a mechanical conveyor; and during the course of their travel they grow, piece by piece, into complete cars. Up to a certain point, the chassis are assembled on a smaller line; and, similarly, the motors are put together on a line of their own preparatory to their installation in the cars.

The starting point in the building of a car is the assembly of the chassis or frame. The first operation consists of riveting to each of the two pressed-steel side members various suitable metallic pieces that will serve later as supports for the motor, hangers for springs, etc. Next, the side pieces are joined together by riveting in place the five cross members whose function it is to give the chassis strength and rigidity as well as to provide support and anchorage for the motor, transmission, and other parts of the driving mechanism.

Cold rivets, most of them $^{9}/_{16}$-inch in diameter, are headed on Hanna riveters. These are operated with compressed air and are capable of exerting a compressive or squeezing effort ranging from 12 and 15 tons in the case of the smaller sizes up to 20 tons. These riveters are heavy, stationary machines, and the pieces are moved into position by hand—being supported on frames suspended from an overhead rail by means of spring hangers. One such riveter will drive more than 2,500 rivets during a 9-hour day. The frames pass successively from one machine to another during the course of their assembly. The last machine rivets in place the side supports for the running boards, after which the chassis is carried by truck to a short assembly line.

On this line, the chassis rests upside down on skids and is moved along by hand from one group of workmen to another, until its assembly is completed. At the various stopping points, the splash pans, springs, and front- and rear-axle assemblies are mounted—pneumatic tools being largely employed in this work, especially for running up nuts on bolts. They perform this tedious operation in a small fraction of the time that would be required if it were done by hand. As several of the accompanying pictures show, the pneumatic tools are suspended, within easy reach, on recoil-spring attachments which automatically draw them upward and out of the way when they are released after use. Each differential is filled with grease by means of an air-driven plunger that injects the exact amount required.

When this preliminary assembly has been completed, the chassis is picked up by an air hoist and grasped in such a way by an especially designed frame that it can be turned over and deposited right side up on the main assembly line, which is an endless chain conveyor on which suitable rests for carrying a chassis are



1—Bodies for closed-car models are lowered on to the proper chassis from the floor above the assembly line by means of an air hoist.
2—Wheels of the artillery type are spray painted while revolving on a spindle.
3—Screwing spark plugs into place with an air-driven tool. The crank case of the motor on the extreme left is being filled with oil by air pressure.
4—Running up nuts on body bolts with a No. 6 air drill.
5—Before receiving its motor and superstructure, each chassis is enameled by air brushes.

General offices of Durant Motors, Inc., at Elizabeth, N. J., with the assembly plant at the left.

mounted at intervals of every few feet. It may be mentioned in passing that air-operated hoists are used variously throughout the plant and that they are a big factor towards promoting efficiency. Only recently it was found that motors being delivered at the plant could be handled six at a time with one of these hoists instead of one at a time, as had been the practice previously. This serves to illustrate how, little by little, plant methods are being improved.

On this main assembly line the chassis moves upstairs to the second floor, and there travels down the lane of workers at a rate that is determined by the production schedule for the day. To increase the output it becomes necessary only to speed up the conveyor and to add a proportionate number of men to maintain the higher rate of assembly. Obviously, there is a limit to the number of workers that can be grouped along the line, and hence also a fixed maximum capacity for the line. Such an assembly line as has been described has a normal capacity of 300 finished cars per day of nine hours. At this rate of progress, a completed car leaves the line every 108 seconds, or 33 machines per hour. The conveyor is driven by an electric motor, and at convenient points there are switches by which the movement of the conveyor can be stopped in case operations anywhere along the line should lag and require extra time to finish them.

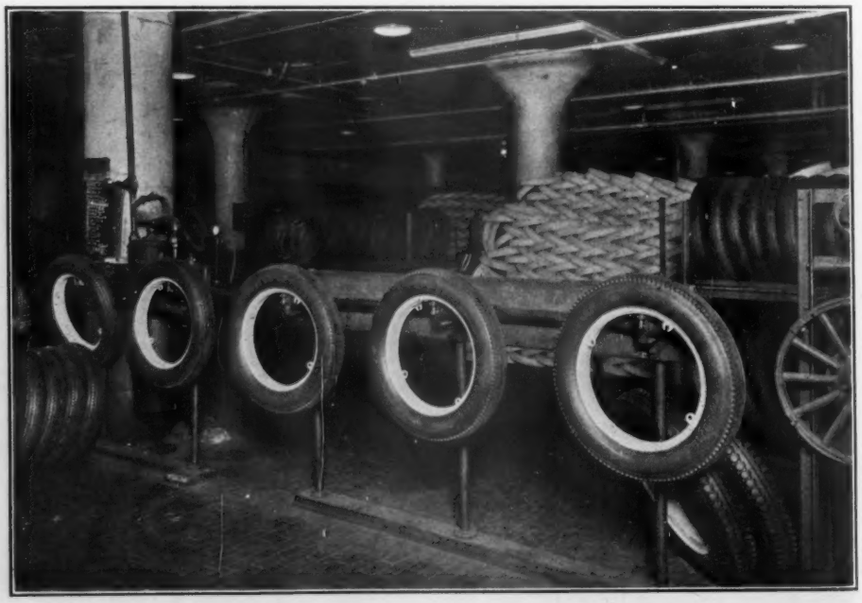
As the chassis is carried forward, workmen quickly build it up, and with each additional contribution it begins to take on the semblance of a car. Most of the operations involve the bolting on of parts, and that calls for the use of handy, efficient air-driven tools. Just before it is to receive its motor, the chassis, minus the wheels, is given a coating of black enamel. This is applied by means of air brushes—a workman with an air-brush or sprayer being stationed on either side of the line. Air at 60 pounds pressure is employed for the spraying. It requires but a minute or two for the enameling of all exposed surfaces. The painted chassis immediately enters an electrically heated oven, where the enamel is baked on under a temperature of 280° F. It then passes through a short cooling compartment.

The motor, previously assembled, is lifted into place by an air hoist. A little farther on a chassis, that is destined to become a closed-car model, receives its body from overhead. This superstructure is lowered into position by an air hoist and through an opening from the floor above. It should be borne in mind that during the course of an average day a great many different types of cars are made up on the same line. For instance, there will be 4-cylinder and 6-cylinder models, and there will be touring cars, roadsters, coupés, sedans, coaches, etc., in addition to trucks and commercial cars. Each of these calls for individual treatment, as well as the correct motor, the right body, wheels, etc. Confusion is avoided by mapping out a schedule which shows, car for car, the make-up of the assembly line for the following day. The personnel of every station along the line and of the departments which furnish material or parts to them, accordingly know just what is required for each car and are prepared as it comes along. The wheels are the last things to go on the car. These have previously been painted by air spray and equipped with rims and tires. The tires have been fitted on the rims by means of pneumatic rim assemblers and have been inflated to the desired degree on an air manifold that fills six tires simultaneously.

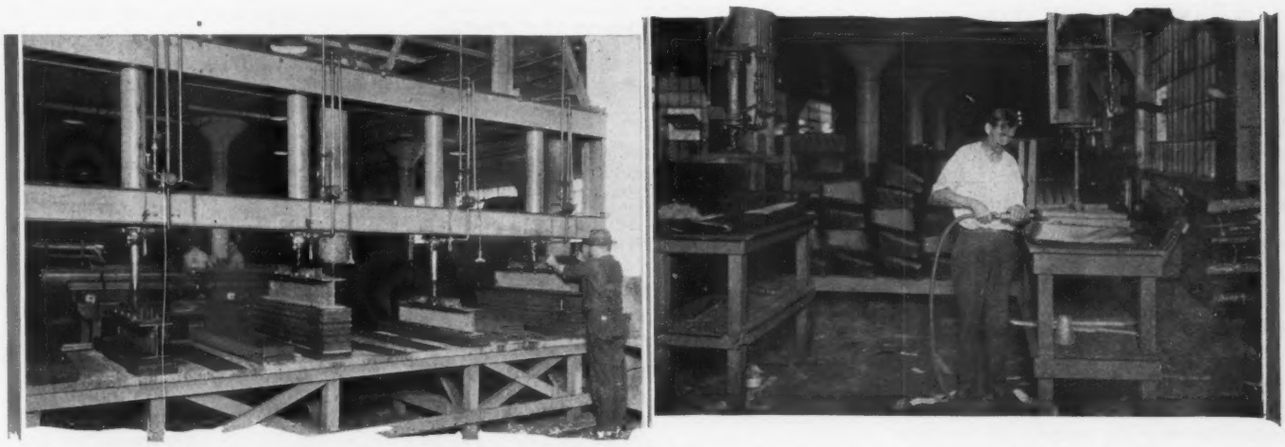
As each car reaches the end of the line a driver enters it, starts it, and puts it through a prescribed test. Except for adjustments, it is then presumed to be ready for use. In other words, the work all along the line has been performed with such care and precision, and has been inspected so thoroughly from time to time, that there is ample warrant for the belief that nothing will be found wrong. However, as an added precaution, every machine undergoes a rigid final inspection; and on a tag, which is attached to its steering post, notations are made concerning any faults or defects that may be discovered. When these are corrected and the motor is tuned up, then the hood is adjusted, and another car has been added to the output of the plant. Every twenty-fifth machine that comes off the line is given a road test. This means that it is actually taken outside the plant and driven at varying speeds for a sufficient time to prove that it functions properly.

In this hasty survey of the building of a car, numerous operations performed by compressed air have not been touched upon. Some of the more important ones may be mentioned briefly. Among these is the painting of bodies, which is carried on in the Hayes-Hunt plant. A primer coat of brown is first applied. This is dried in an electrically heated oven having a temperature of 150° F. The cars are moved through this oven by means of the thrust of a piston actuated by compressed air. The bodies are then given a number of successive coats of a nitro-cellulose lacquer, which dries almost instantly. All painting is done under mercury-vapor lights, the rays of which serve to make defects readily visible. The painting of radiator hoods in the Durant portion of the plant is accomplished in like manner. The only painting done by hand on any of the cars is the placing of the narrow stripes sometimes used as embellishments.

Air-operated presses assist in binding the rubber mats to the surfaces of the running



Air manifold which inflates six tires at a time and puts them under the desired pressure.



Left—Ribbed rubber mats are affixed to the running boards with water-glass cement. A firm bond is secured by subjecting the parts to pressure in these air-operated presses.
Right—While an air piston compresses the springs in the cushion, an operator with a pneumatic beading tool fastens the cover to the spring base.

boards. A water-glass cement is applied to the covering, which is laid in place on the strip of wood. Piles of these are then put under pressure in a press until the cement is dry. Again, in making cushions for the seats, an air-driven plunger holds the springs down while a workman slips the cover over them and secures it in place by crimping metal around the base wire by means of a pneumatic beading tool, as shown in one of the illustrations.

Realizing that the efficiency of air-driven tools is increased and their life prolonged by regular inspection and upkeep, the Durant Company has on its payroll a trained workman who devotes his entire time to their maintenance and repair. Once each week he makes the rounds of the plant, inspecting and oiling all pneumatic tools and machinery. As a result of this systematic care, the compressed-air equipment is always up to its maximum capacity and the quality of the work performed is kept at a high standard.

NEW CABLE TO SPAN THE PACIFIC

TO keep pace with our growing trade with the Far East, which has jumped from a total of $487,000,000 in 1914 to $2,105,000,000 in 1926, the Western Union Telegraph Company is completing plans to augment the cable service between the United States and the Orient. At the present time there are three cables and five radio circuits operated across the Pacific, as compared with twenty cables and twelve radio circuits connecting the United States with Europe. Our trade with that continent in 1926 amounted to $3,596,000,000.

It has not yet been decided what route the proposed high-speed cable is to follow; but as the number of messages that a cable can handle decreases as the length of the cable increases it is very likely that the northern or shorter route will be chosen. This has a length of 7,100 miles, and extends from Seattle to Dutch Harbor or Atka in the Aleutian Islands; thence to Hakodate in northern Japan; from which point it finds its way to Shanghai and Manila. The cost of the undertaking is set at $10,000,000.

CAR SIGNS PAINTED BY SPRAY METHOD

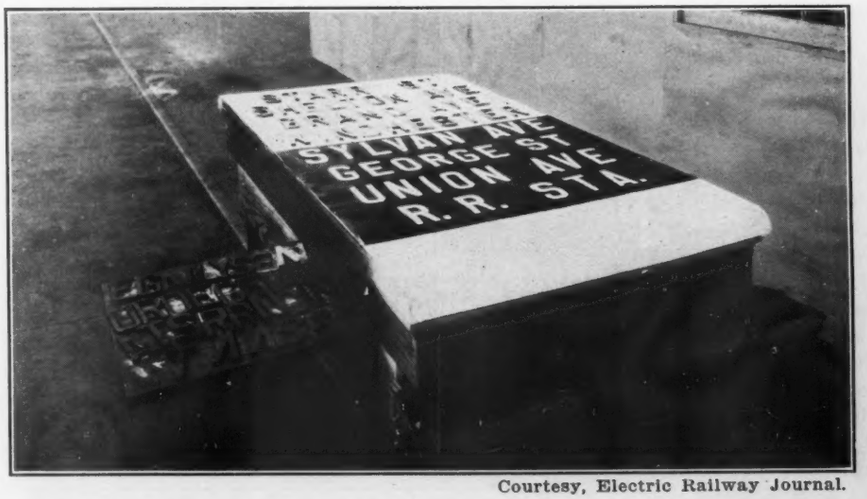
UTILIZING an idea advanced by J. E. Dooley, master mechanic, spray painting is being successfully employed at the Grand Avenue shops of the Connecticut Company, New Haven, in the preparation of cloth roll signs for street cars.

A piece of cloth of required dimensions is laid on a low table and secured in a flat position by means of thumb tacks. Patterns for the letters consist of babbit metal cast in forms prepared in the shop and are three-eighths of an inch in thickness. These metallic letters are laid on the cloth so as to spell out the desired sign. A T-square serves to keep the lines straight, the spacing between letters being done by eye.

When several lines of the pattern have thus been set up, that portion of the sign is sprayed. Adjoining portions of the cloth are protected from the paint by pieces of heavy paper. Black paint is used, forming a solid background except for the spaces occupied by the patterns. The weight of the metallic letters prevents their accidental displacement during the painting process. After spraying, the letters are lifted from the cloth by means of wire handles and laid on a tray for use in composing the next sign.

Signs prepared in this manner are neat and clearly legible. They can be prepared quickly and at moderate cost. The Connecticut Company has for some time past been using this method for the painting of metal car signs.

At the Port of Calais, France, it is reported in *Tycos*, has been installed a new device that makes it possible to guide vessels into the harbor during times of heavy fog. This invention consists of a siren that emits a sound having vibrations of such high frequency that they are imperceptible to the human ear. Directly below the siren is a wireless aerial. This aerial is connected to an apparatus, placed underwater, that projects the sound waves outward over a very small arc of a circle. Any ship carrying a suitable receiver can pick up these sounds and head straight for port—thus making it unnecessary to lie at anchor awaiting the lifting of the fog before entering the harbor.



Courtesy, Electric Railway Journal.

On the near end of the cloth strip is a completed sign. Above it, the cast-metal letters for another sign are arranged ready for spray painting.

TWIN DIVING SUIT WILL AID UNDERWATER WORK

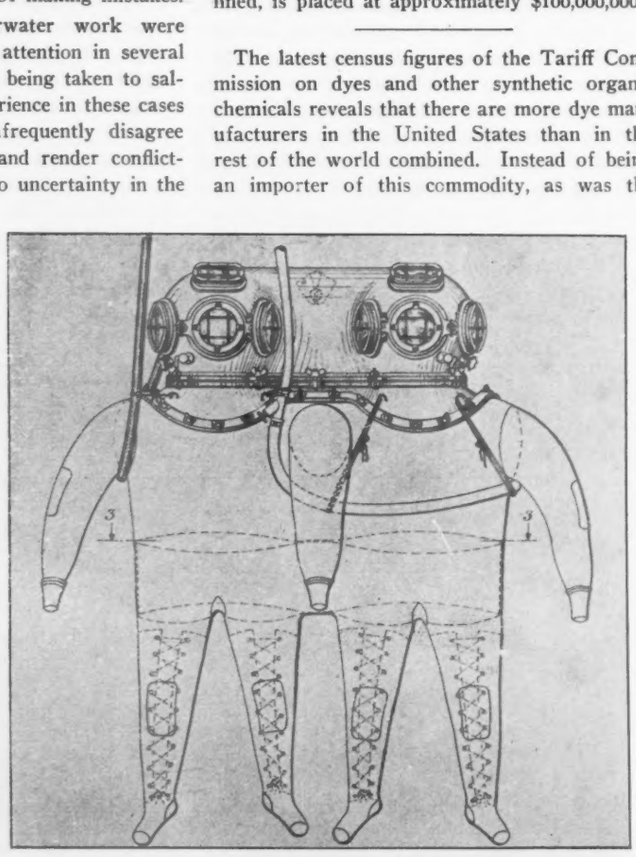
THE twin diving suit shown in the accompanying sketch is the invention of Dr. Edward Levy, physician to the Board of Transportation, New York City, to whom a patent has recently been issued. The purpose of the duplex suit is to make it possible for a trained diver to take a companion underwater with him. The diver will occupy the portion of the suit that appears on the left in the diagram, and he will manipulate the air supply and the lines of communciation with the surface, thus leaving the second person free to make observations.

It will be noticed that there are but three arm compartments. The occupant of the right-hand section of the suit, as viewed in the illustration, will place his right arm about his companion so as to steady both persons and to aid in securing unison of movement when it is desired to walk about.

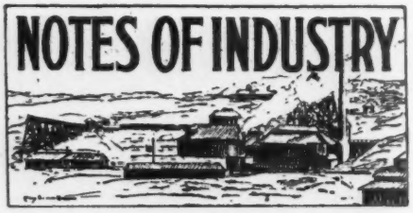
It is believed that the invention will prove of considerable practical value, because it will enable engineers who are not divers to go underwater to personally inspect conditions and to superintend work after the proper course of procedure has been determined. Heretofore the director of subaqueous operations has, in many instances, had to depend almost entirely upon information given him by divers. This indirect method of surveying the ground and of supervising activities not only has complicated the engineer's problems but has, moreover, increased the chance of making mistakes.

These aspects of underwater work were brought to Doctor Levy's attention in several instances where steps were being taken to salvage sunken vessels. Experience in these cases showed that divers not infrequently disagree as to what they observe, and render conflicting reports that give rise to uncertainty in the mind of the engineer who must ultimately decide just what steps are to be taken. Whether or not the engineer be a trained diver, the twin diving suit will enable him to make a personal survey of the scene of operations, thus greatly simplifying his work and saving much time.

The Gillette coal field in northern Wyoming, a considerable part of which is owned by the United States Government, contains more than 14,000,000,000 tons of coal in workable seams. So far, production has been limited by the demand; but exploration has shown that great tonnages can be mined by stripping.



Sketch of the twin diving suit which will enable the professional diver to take an observer underwater with him.



A process has been developed in the United States, we learn from *Coal Age News*, for the production of synthetic methanol from bituminous coal. Synthetic methanol is a solvent like wood alcohol, and is used in the manufacture of dyestuffs, lacquers, bakelite, etc. By the process, hydrogen and carbon monoxide—both the products of bituminous coal—are caused to react, in the presence of a catalyst, while they are highly compressed and heated. It is said that commercial quantities of methanol are being manufactured by this method in a plant at Belle, near Charleston, W. V.

A tentative scheme for the construction of a system of underground railways is being considered by the Manchester City Council as a means of relieving the increasing traffic congestion of that thriving English town. The plan provides for a series of subways radiating from the center of the city out to the suburbs, as well as an inner and an outer belt line. The inner belt is designed to link up the six principal railway stations of Manchester and nearby Salford. The cost of the project, as outlined, is placed at approximately $100,000,000.

The latest census figures of the Tariff Commission on dyes and other synthetic organic chemicals reveals that there are more dye manufacturers in the United States than in the rest of the world combined. Instead of being an importer of this commodity, as was the case not long ago, we now produce enough dyes for our own needs and have a large surplus for shipment to foreign markets.

Truck refrigeration has been introduced with success in California in bringing to market from some of the rather warm valleys such perishable foodstuffs as butter, eggs, meat, etc. It is reported that since the service was inaugurated during the early part of the past summer, and on hauls of 215 miles from the San Joaquin Valley to the coast, not a pound of any commodity has been lost or its market value reduced through lack of speed in transportation or failure of the refrigerating system.

The use of ice for roadbuilding is something of a novelty, but it has been tried out with success in Russia in conducting logging operations. Something over 350,000 cubic feet of wood were transported during a 3-month period over an ice-topped road about two miles long; and in this work 1-horse sleighs were used having a width between runners of 3.25 feet. Because of the reduced friction, as compared with haulage over snow, the animals were able to draw anywhere from six to eight times their own weight. Besides effecting a considerable saving in the cost of logging operations, the ice roads made it possible to cut down the number of draft animals ordinarily required.

At a recent meeting of the French Academy of Sciences, press reports have it, there was submitted a scheme for a tunnel linking Spain and North Africa. The plans were prepared by Señor C. Ibanez de Ibero, a Spanish engineer, and call for a tunnel beneath the Straits of Gibraltar at a point where that waterway has a depth of approximately 1,300 feet. The maximum length of the proposed tunnel is about 32 miles, of which about 20 miles would be under the straits.

The wearing qualities of cast-steel and wrought-iron anchor chains have been made the subject of an investigation by the United States Lighthouse Service. Reporting on the tests, the superintendent of the third lighthouse district says: "The results indicate that cast-steel chain, while costing 10 per cent. more than that of iron, has wearing qualities 30 per cent. greater; strength 33 per cent. greater; and weight 4 per cent. less than wrought-iron chain."

Officials of the United States Bureau of Mines are interested in the discovery in the State of Nevada of what is claimed to be a large deposit of Hübnerite—a manganese tungsten ore that is not plentiful in this country. The find, according to the *Nevada Mining Press*, was made by George B. Wright, president of the Gold Star Mining Company, and is located at Indian Peak in the Humboldt Range. An engineer of the United States Geological Survey, who is an authority on tungsten ores, has been assigned to make an examination of the claim.

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EDITORIALS

The Season's Greetings

MAY all possible happiness and prosperity be yours in the New Year! We send you this greeting with added fervor because our message goes farther and reaches more readers than heretofore.

During the twelvemonth just ended, our mailing list has been augmented by 4,073 names—that is to say, the list is 14 per cent. longer than it was in December, 1926. In all probability, our pages are read by fully 12,000 more persons than a year ago. This recognition, this evidence of interest in what we are trying to do is most encouraging; and we shall work hard in 1928 to earn further regard by following still closer the constructive suggestions offered by our readers from time to time. Be sure that we are heartily appreciative of this source of inspiration and guidance.

OUR FOREIGN TRADE GROWS

THE steady expansion of our foreign trade is dealt with in a convincing manner in the last annual report of the Secretary of the United States Department of Commerce. As pointed out in that document, "Successful and growing international trade is a primary national function, both to find markets for surplus production and to furnish the means of exchange for those commodities which we do not ourselves produce and upon which our whole economical life and comfort depend."

More than once latterly we have been reminded by propagandists that the expansion of our trade is inevitably at the expense of the prosperity of competitive nations. This opinion is not justified, and upon this point we are authoritatively informed by the Secretary of Commerce: "The expansion of the foreign trade of the United States has been of benefit not only to this country but to the rest of the world. It is not true, as sometimes supposed, that our exports have expanded at the expense of the trade of competing countries. The growth of our exports has been a normal growth, merely continuing that which took place before the war. It reflects the general progress of our industry, and it represents our proportion of growing world demand. The rapid growth of our imports, outstripping that of exports, has furnished markets of inestimable value to other countries throughout the world. Despite the expansion of our own manufactures we are importing more manufactured goods from Europe itself than ever before.

"The task of increasing our exports of manufactured goods has been met partly by reduction of costs and increase of output per man. In part it has been met by greater attention to foreign marketing on the part of our business men, our merchants, and the Government itself. The success achieved is no less than extraordinary. Our exports of finished and partly finished manufactures in the fiscal year just closed amounted to no less than $2,670,000,000. This was an increase of 168 per cent. over the pre-war average and of 65 per cent. over the year 1921-22. The rate of growth of exports of finished manufactures—which are more competitive than the partly finished, as compared with the pre-war figures, has been even more rapid. Finished manufactures represented 31 per cent. of our exports from 1910 to 1914, and 41 per cent. in 1926-27. There is little doubt that manufactured goods will continue to gain in relative importance in our export trade.

"Not only is the United States likely to increase its capacity to produce and to maintain its ability to compete with other manufacturing countries in world markets, but there is also reason to anticipate that world demand for goods will expand, provided always that peace is maintained. The same causes which are tending to build up productive capacity and to advance living standards in the United States are at work all over the world."

NORTH POLE TORRID BY CONTRAST

AN Eskimo wintering at the North Pole would swelter in his bare skin had he been born in an atmosphere as cold as it is possible to provide in a modern cryogenic laboratory, where temperatures are reached that are only a shade above absolute zero. Absolute zero, by the way, is that degree of coldness that prevails in interstellar space.

It is fresh in the minds of many of us how, some years ago, Professor KAMMERLINGH-ONNES succeeded in liquefying helium in his laboratory at Leyden. Afterwards, by the rapid evaporation of that liquid helium, the thermometer indicated a temperature of only 2.5 degrees above absolute zero—that is to say, a temperature of 458.5 degrees below zero Fahrenheit. The mind is utterly incapable of conceiving the intensity of such an extreme cold.

The work done by KAMMERLINGH-ONNES in his pioneer cryogenic laboratory has led to the establishment of other laboratories of the same sort; and the latest of these was recently opened in Berlin. The curious-minded may reasonably ask, What useful purpose is served by cryogenic laboratories, where temperatures are produced by man that are lower by 383.5 degrees than the lowest recorded temperature at the earth's poles? The answer is: Many metals and other forms of matter acquire or lose distinctive characteristics when subjected to such coldness, and some of them show vastly improved capacities for the transmission of electrical current. These alterations are principally due to the arrest of molecular movement; and it is conceivable that cryogenic laboratories may be employed to study to advantage molecular action from its very beginning onward to those stages prevailing generally. It is highly probable that the intense cold, attainable in this manner, may serve to reveal further secrets of Nature which man may put to his use in one way or another.

HOW FAR FORESTS AFFECT FLOOD CONTROL

REFORESTATION has been urged as a means of safeguarding the people of the Mississippi Valley from another disastrous flood. A great many persons have accepted without question the promised benefits of such a course; and to those we strongly recommend the reading of an especially informative and comprehensive paper prepared by RAPHAEL ZON of the Forest Service of the United States Department of Agriculture. This paper is entitled, *Forests and Water in the Light of Scientific Investigation.* We cannot do more than summarize the outstanding points that have been brought out by MR. ZON. He has made it clear that forests, at best, can temper only moderately the flow of flood waters due to abnormal precipitation.

Forests serve to bind the soil of the forest floor. In this way they arrest or prevent erosion, and to that extent diminish the

amounts of sand, gravel, earth, etc., that might otherwise be swept into streams—thus raising the level of the stream beds and increasing the volume of matter in motion in the flood body. It has been ascertained that a forest floor can, under very favorable circumstances, retain a precipitation of about one quarter of an inch. When the precipitation over a brief span of time amounts to several inches, it is self-evident that all but that one quarter of an inch must be carried down into neighboring streams or valleys and swept seaward at a dangerously rapid rate. Forests can, therefore, delay for a while the development of the flood crest.

Where the precipitation is not abnormally excessive, forests may check an abrupt and menacing rise in the stream or streams draining the watershed—to that measure being beneficial; but it is understandable that reforestation alone could play only a minor part in preventing a recurrence of flood conditions such as ravaged the Mississippi Valley last year. Many other agencies must be provided to assure protection.

HUM OF PLANE TURNS ON FIELD LIGHTS

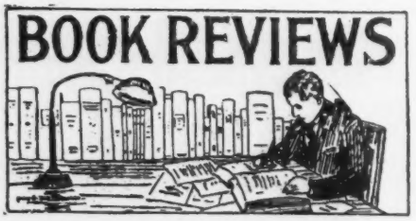
THAT the drone of an airplane can be put to practical use has been demonstrated by an electrical research engineer who has devised an automatic lighting apparatus that is sensitive to sound. During a recent test at an airplane landing field, the noise made by the hum of a machine 1,000 feet aloft served to close a switch that turned on a bank of flood lights, thus enabling the pilot to make a safe landing at night.

According to the *Journal of the American Institute of Electrical Engineers,* a loud speaker, operated reversely, is the "ear" of the mechanism. By laying the loud speaker on its back, the apparatus is given a directive effect with reference to noises coming from overhead. A microphone completes the auditory part of the device. After passing through several amplifiers, the impulse goes through a time-limit relay—the last step before the current automatically throws the lighting switch and locks it. Obviously, the purpose of the apparatus is to do away with the need of keeping airplane landing fields lighted from nightfall to daybreak.

More than 10 miles of evergreen trees were planted during the fall of 1927 by the Canadian Pacific Railway along its right of way in the Province of Quebec. These serve not only to replace ugly fences but to prevent snow and ice from drifting on to the tracks. Hedges of this description now flank 110 miles of the company's lines.

A CORRECTION

In the final rush of editorial work on the October issue of COMPRESSED AIR MAGAZINE, The Hague was mistakenly referred to on page 2193 as the capital of The Netherlands. Amsterdam, of course, enjoys that distinction, and The Hague is the residence of the royal family and the governmental authorities.



THE BUREAU OF ANIMAL INDUSTRY, by Fred Wilbur Powell. A book of 190 pages, published by the Johns Hopkins Press, Baltimore, Md. Price, $1.50.

THIS book is one of numerous service monographs of the United States Government compiled under the auspices of the Institute for Government Research. In this case, we have the presentation of that bureau of the Department of Agriculture that is immediately concerned with the promotion of the livestock, meat, and poultry interests of the United States and with the protection of the public health against dangers from animal sources. The subject is handled in the thorough manner that characterizes all the service monographs of the series.

METAL STATISTICS 1927. A book of 544 pages, published by the American Metal Market, New York City. Price, $2.00.

THIS is the 20th annual edition of *Metal Statistics;* and, agreeably to the continual aim of the publishers, an effort has been made to furnish statistics that provide the information most generally required by producers and consumers, and by buyers and sellers of metals. The work has a broad and well-defined field of usefulness.

DESCRIPTIVE GEOMETRY, by C. H. Schumann, Jr., Assistant Professor of Drawing, Columbia University. A volume of 249 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $2.50.

AS the author says in his preface: "Contrary to popular opinion, descriptive geometry is an intensely practical subject; and because it is the basis and theory of mechanical drafting its principles must be employed whenever drawings are made and structures designed. Descriptive geometry is a language just as English and French are languages. Unlike these latter it cannot be spoken, but is a written language only—a graphical method of representing exact thoughts on paper. It must be studied and used to obtain proficiency in its applications."

This book will be helpful to any one requiring such a knowledge of geometry in his work.

MECHANICAL APPLIANCES AND NOVELTIES OF CONSTRUCTION, by Gardner D. Hiscox, M. E. An illustrated work of 412 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $4.00.

THE present volume supplements an earlier work, entitled *Mechanical Movements,* and will no doubt be found a valuable companion to the earlier book. There are chapters on the mechanical power lever, the transmission of power, the generation of power, air-power motors and appliances, hydraulic power and appliances, electric power and devices, gearing and gear motion, mining devices and appliances, and radio telegraphy and telephony.

PRINCIPLES OF SELLING BY MAIL, by James Hamilton Picken, M. A. An illustrated work of 374 pages, published by A. W. Shaw Company, Chicago and New York. Price, $6.00.

PRIMARILY written as an introduction to building business by mail, this book offers the reader a complete method both for writing and for using letters in business promotion. Experience has developed certain fundamental rules or formulas for selling by mail, and a knowledge of these will help to avoid mistakes and lost motion or waste effort. As in all business contacts, a knowledge of human nature and of the other man's point of view will always help tremendously towards success; and an appreciation of these is even more essential where intercourse is by writing.

PHYSICS IN INDUSTRY, by Walter Makower and Bernard A. Keen. An illustrated book of 63 pages, published by the Oxford University Press, New York City. Price, $1.00.

THIS book contains two very able papers: the first dealing with *Physics in Rubber Industry,* and the second with *The Physicist in Agriculture.* In each case, the author has handled his subject in a thoroughly understanding and understandable manner. The paper on the rubber industry has mainly to do with the manufacture of pneumatic and other tires—a topic that concerns every owner of an automotive vehicle. The paper on *The Physicist in Agriculture* opens up a new field of investigation and brings to a focus aspects of the soil not commonly considered by the average farmer. Even so, the farmer will benefit in time through the effort of the physicist.

MECHANICAL ENGINEERING, issued in two volumes by the Economic and Financial Section of the League of Nations. To be had in the United States from the World Peace Foundation, Boston. Price, $2.25.

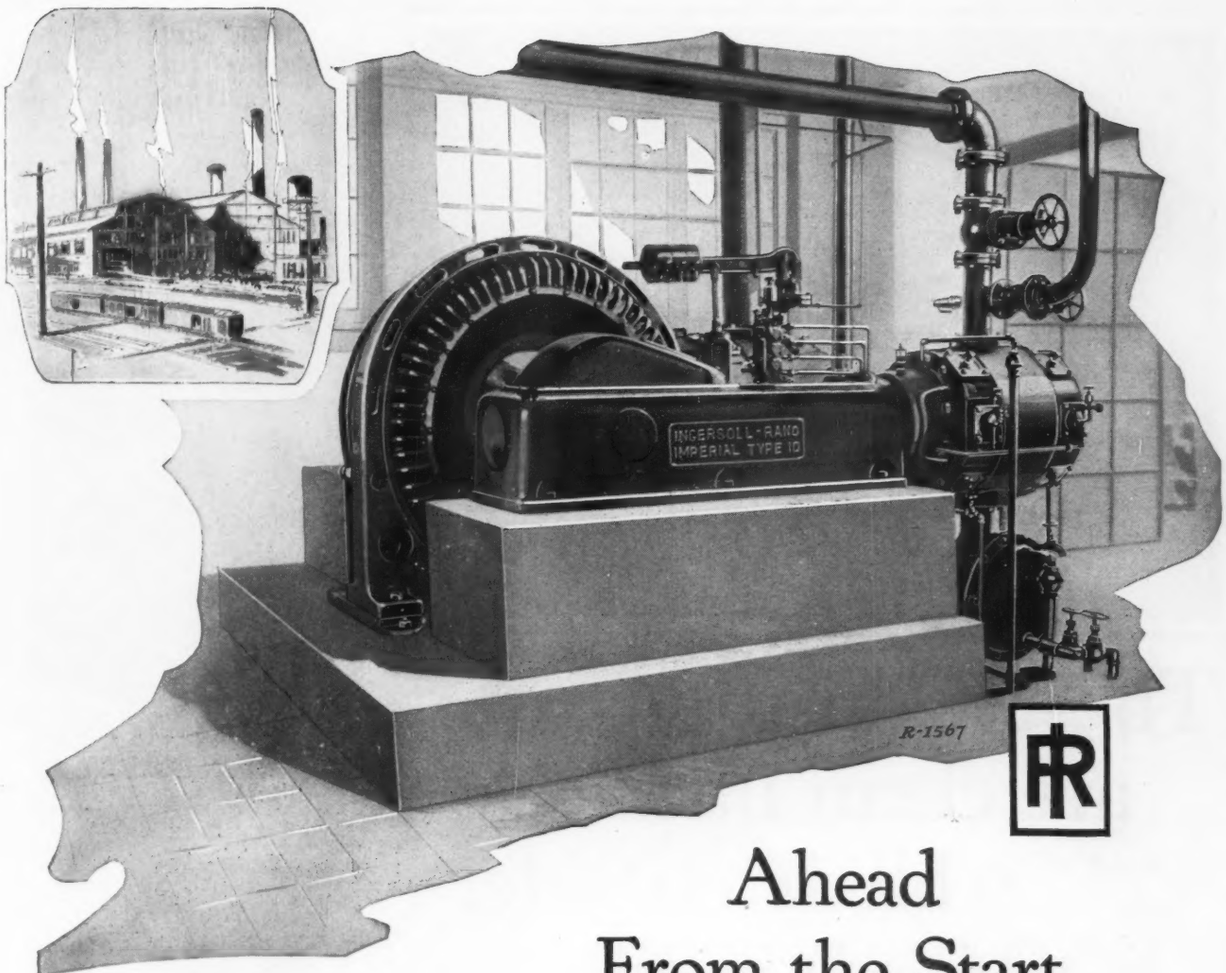
THESE volumes present much valuable data having to do with the world's mechanical-engineering industry. They are compilations of information, statistical tables, and of summaries that give the most comprehensive and authentic array of up-to-date facts and figures.

YEARBOOK AMERICAN ENGINEERING STANDARDS COMMITTEE, 1927. A work of 80 pages, issued by the American Engineering Standards Committee, New York City.

THIS publication is an annual review of progress in the standardization movement that has for its ultimate goal the reduction of unnecessarily numerous sizes and the acceptance of standard specifications that will promote universal practices making for operating and output economies in industry.

DRAFTING FOR ENGINEERS, by Carl Lars Svensen, M. E. An illustrated volume of 363 pages, published by the D. Van Nostrand Company, Inc., New York City. Price, $2.75.

NOT only is a knowledge of drafting needful in the study of engineering but it has its application in every department of the profession of the engineer. In other words, the qualified engineer should know both how to make drawings and how to read them. This book is carefully and comprehensively compiled; and deals with the subject in all essential phases.



Ahead From the Start

With the rapid development of electric power, it has become evident that direct connection to synchronous motors is, in a great many cases, the ideal type of drive for Compressors. Ingersoll-Rand Company has been a pioneer in this work and has constantly forged ahead in the development of such type of machine.

The Type XRE Compressors shown above are of the synchronous-motor-driven type and are available in sizes as small as 100 hp.

Proper unloading and regulation for these machines have been so developed in our 5-step Clearance Control Regulator that the most flexible demand is automatically and efficiently accommodated. With this patented control, the power input is practically proportionate to the load, whether the machine be operating at full, three-quarter, half, one-quarter, or no capacity.

Ingersoll-Rand representatives are located in all parts of the world. They will be glad to consult with you on your Compressed Air problems.

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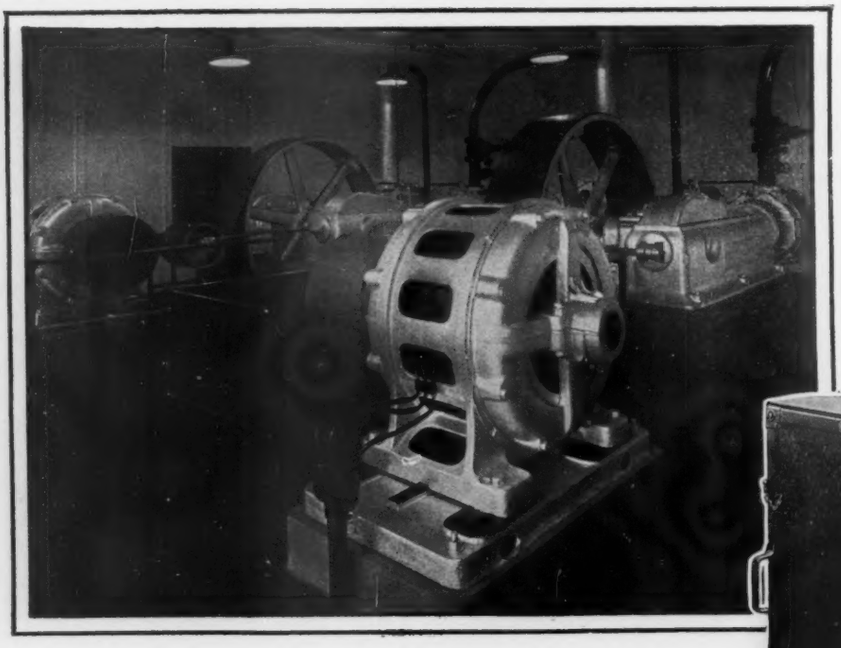


The two double-unit Reed Air Filters used on the two 870-C.F.M., Type XCB, Ingersoll-Rand Compressors shown here remove 97% to 99% of all harmful dust, dirt and grit from the intake air. Reed Air Filters, easily attached to the air intake, are made in various capacities for every size and type of air compressor or oil engine.

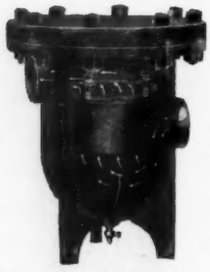
The Reed Two-Unit Air Filter for compressors or engines of 1200 C.F.M. or less.

These Compressors are clean *inside* as well as *outside!*

KEEPING the outside of your compressor clean is largely a matter of appearance. *But keeping the inside clean saves its life.* By the removal of dirt, dust and grit from the intake air, Reed Filters prevent scored pistons, clogged valves and burnt-out bearings, maintain the original high efficiency of your equipment *and increase its period of dependable service from 25% to 75%.*

Even in ordinary city air, a two-unit Reed Air Filter will remove from one to three pounds of dust, dirt and grit each week. Is this accumulation of abrasives eating away the life of *your* expensive equipment? Get the facts today. The coupon is for your convenience.

REED AIR FILTER COMPANY, *Incorporated*
214 Central Avenue LOUISVILLE, KENTUCKY
Offices in Principal Cities



The Reed Type G Filter for removing entrained oil and water, dust, dirt and grit from high-pressure air lines.

The Reed Type E Filter for small compressors and engines and portable pneumatic equipment.

Reed Air

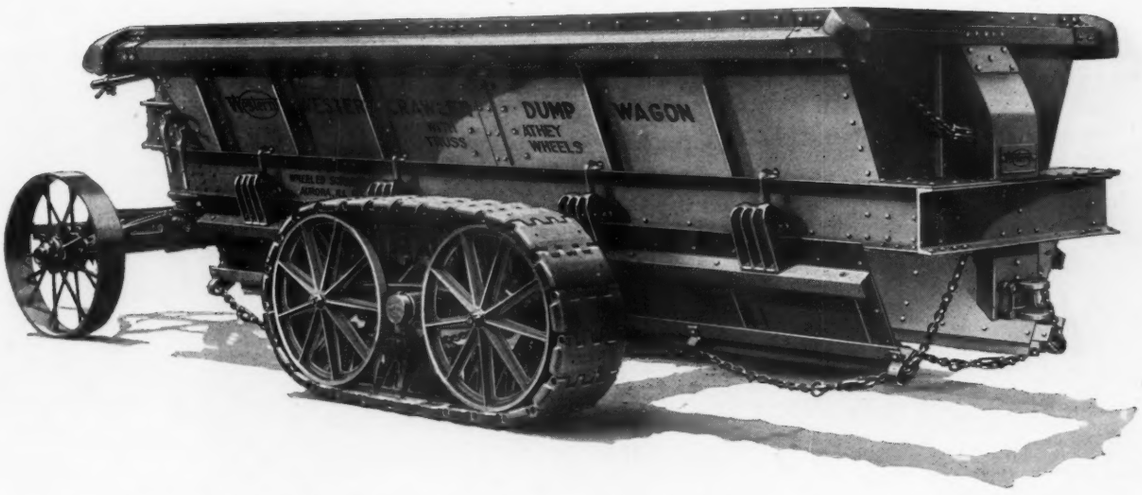
TRADE *filters* ALL METAL MARK

Use This

REED AIR FILTER CO., *Incorporated*, 214 Central Ave., Louisville, Kentucky
Send, without obligating me, your Bulletin No. 110 on clean air for Air Compressors, Internal Combustion Engines and Pneumatic Equipment.

Name ..... City ..... Possible Use .....

Company ..... State .....



Western 7-cu. yd. Crawler Dump Wagon—bottom drop doors open. Athey Truss Wheels, almost frictionless, carry 90% of the load.

Invaluable Around Your Plant

Western

You can find profitable use for one or more of these Crawler Dump Wagons handling waste or other material. Contractors load them with 8-cubic yards and more and handle two wagons with a single 60 Crawler Tractor.

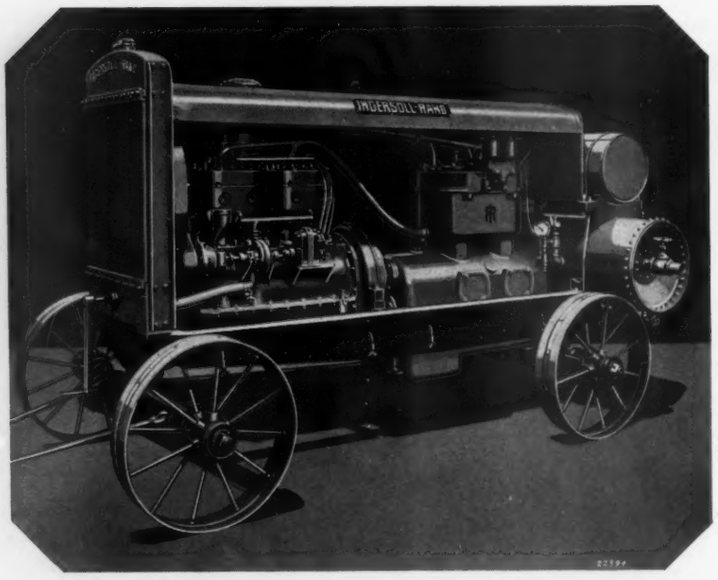
No railway track to lay and maintain; no road to grade. Will go where your tractor goes —in sand, in mud, over rough ground, regardless of weather conditions. Equals in capacity two 4-yard cars, six 1½ -yard dump wagons.

Bulletin 27-SCM tells the whole story of this new Crawler Dump Wagon that is revolutionizing the earthmoving industry. Send for Bulletin 27-SCM please.

WESTERN WHEELED SCRAPER COMPANY

Dump Cars and Grading Equipment

AURORA, ILLINOIS, U. S. A.



Selection of Maintenance Equipment

"Be sure the Company you deal with is one that takes an interest in its sales, not only until your name is signed on the dotted line, but continuously thereafter through the entire life of the machine."

Extract from address delivered by Mr. W. H. Root, Maintenance Engineer, Iowa State Highway Comm. (Convention of American Road Builders Ass'n, Chicago, 1927).

SERVICE is the keynote idea behind all Ingersoll-Rand equipment. An unsurpassed engineering service organization is always ready to advise and help the Ingersoll-Rand user in any problems that he may encounter. Numerous conveniently located offices and stations make it possible to give service when and where it is needed. This is as valuable an asset as the equipment itself.

The Ingersoll-Rand combination of high-class equipment and reliable service means fewer shut-downs, additional profits, and lasting satisfaction.

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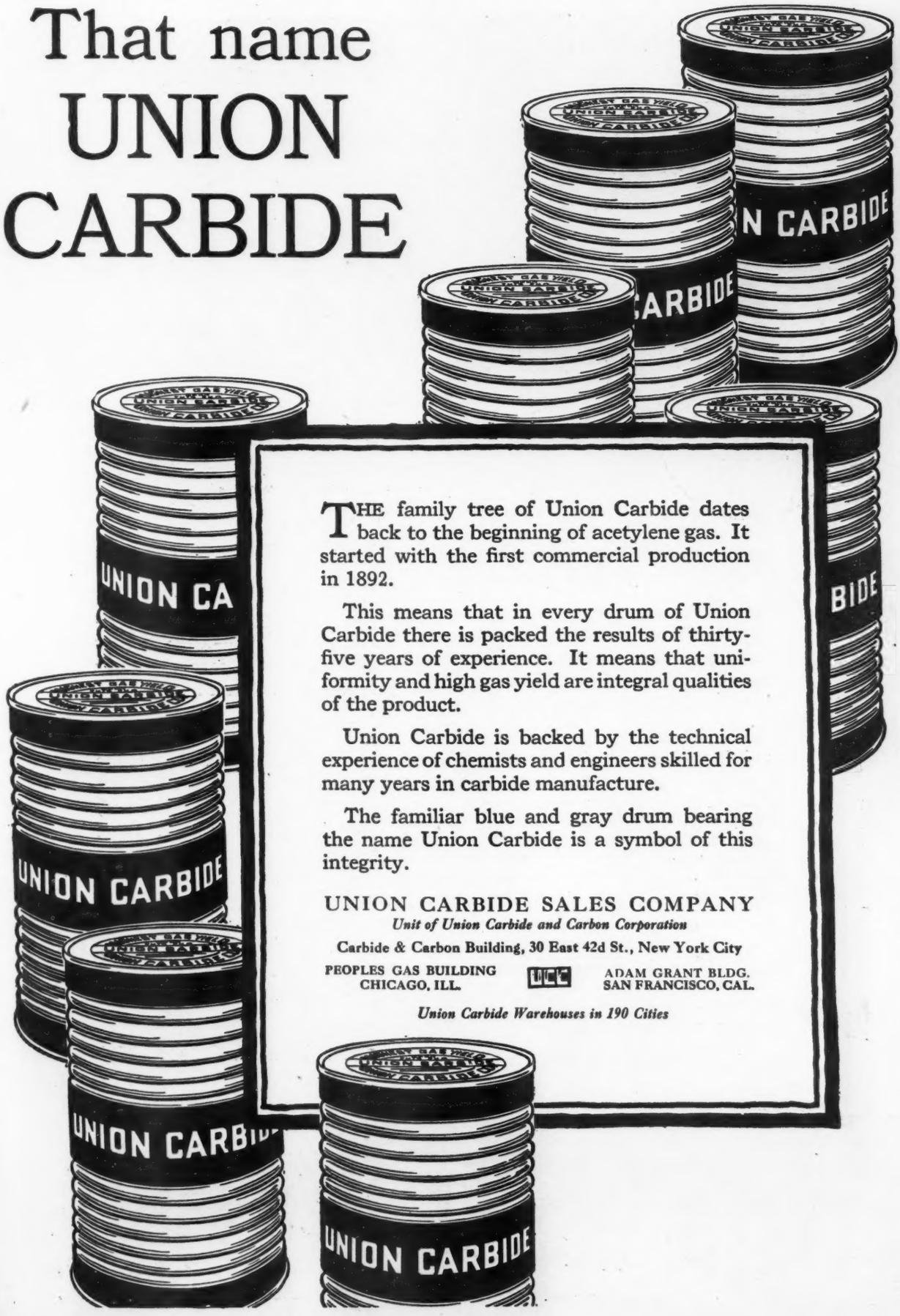
That name UNION CARBIDE



THE family tree of Union Carbide dates back to the beginning of acetylene gas. It started with the first commercial production in 1892.

This means that in every drum of Union Carbide there is packed the results of thirty-five years of experience. It means that uniformity and high gas yield are integral qualities of the product.

Union Carbide is backed by the technical experience of chemists and engineers skilled for many years in carbide manufacture.

The familiar blue and gray drum bearing the name Union Carbide is a symbol of this integrity.

UNION CARBIDE SALES COMPANY

Unit of Union Carbide and Carbon Corporation

Carbide & Carbon Building, 30 East 42d St., New York City

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ADAM GRANT BLDG.
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Try It On Your HARDEST DRIVES!

You have at least one in your plant—a drive that keeps your millwrights busy and wastes money! Try Goodrich "1788 Highflex"—and watch the trouble disappear!

Three years ago, a large New England manufacturer standardized on "1788 Highflex". He has recently checked up his belting cost for the last ten years. Up to the time of installing "1788 Highflex", average yearly cost was $11,000. Since the plant was put on a 100 per cent "1788 Highflex" basis, annual cost has been well under $7,000.

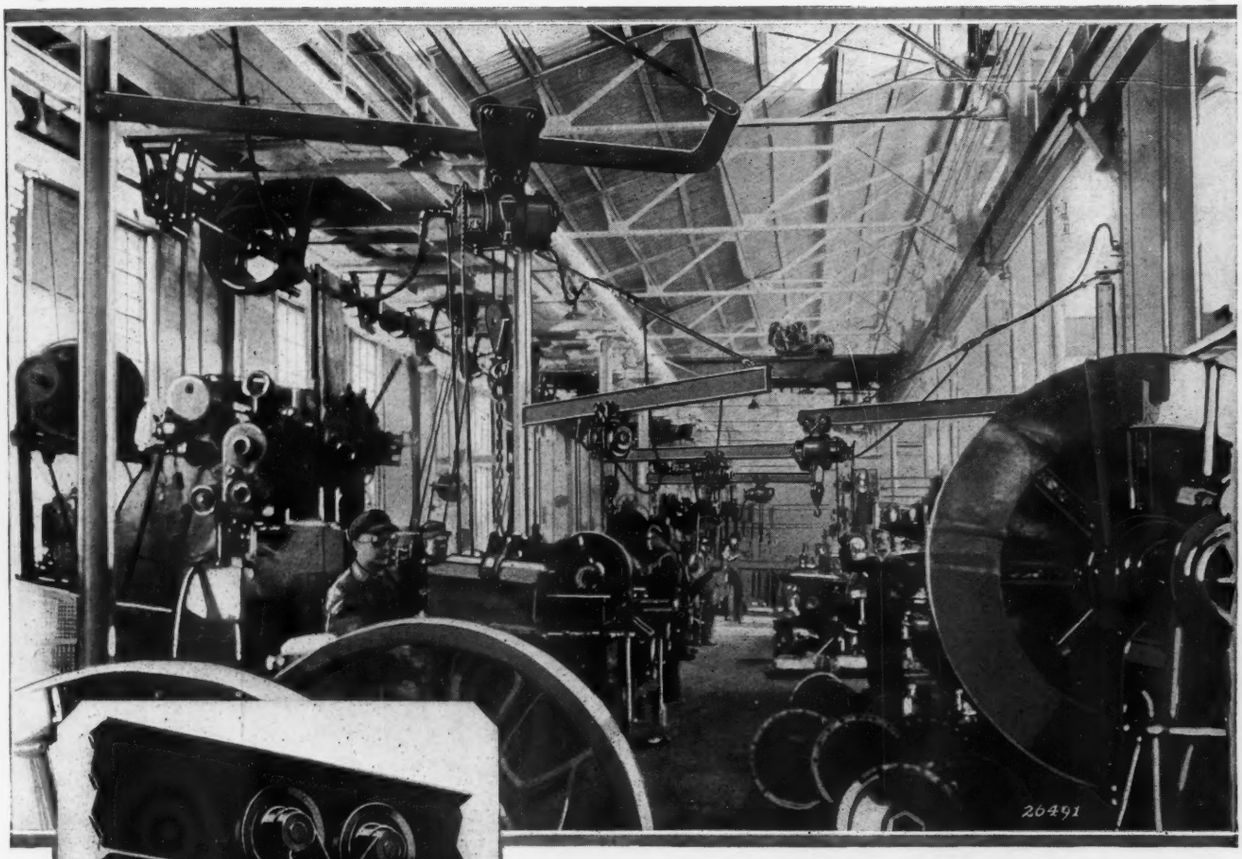
This, remember, is only the saving in actual cost of belting—but low maintenance expense, and the increased production due to fewer shut-downs, represent an even greater saving!

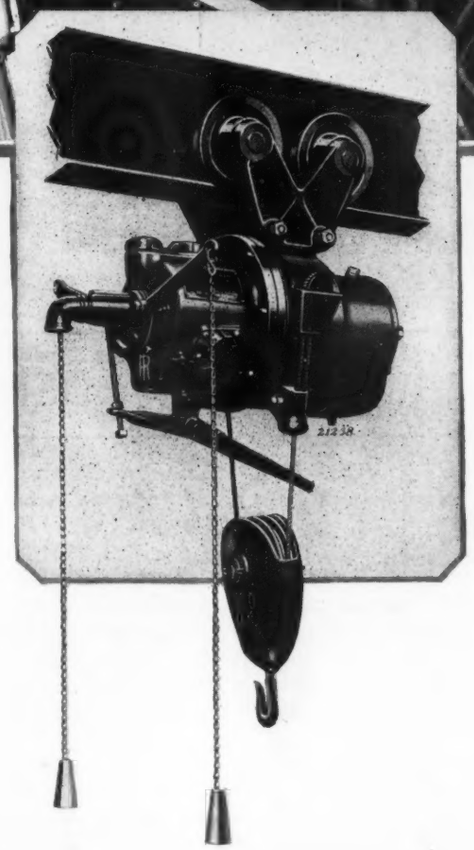
That is why we say—"Try '1788 Highflex' on your hardest drives!"

Free bending of ply on ply.
No folds in the fabric.
No seams to open up.
No ply separation.
No bootlegging.
Made of strongest belt duck—50% less stretch.
Compact weave of fabric gives better anchorage—fasteners won't pull out.
Not affected by atmospheric changes.
Longer life.
Send for folder of valuable horse-power and pulley data.

THE B. F. GOODRICH RUBBER COMPANY
Established 1870 Akron, Ohio

Goodrich
"1788 Highflex" Belt





An installation of Ingersoll-Rand Air Motor Hoists in a railroad machine shop.

SPEED AND SAFETY
WITH THESE HOISTS

Ingersoll-Rand Air Motor Hoists contain many new features not previously combined in any single type of hoist and, in addition, they have many new improvements.

The outstanding features are, briefly: compactness of design with working parts all enclosed; balanced motor that operates without vibration; automatic safety brake which positively holds the load—even if the air supply be disconnected.

For quick lifting and lowering, or for accurate placing of pieces on a machine, I-R hoists are speedy and sure. They require no attention except the occasional adding of oil.

There are other important features you should know about. Ask for complete information. The hoists are built in seven sizes, with capacities ranging from 500 to 20,000 lbs.

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Gouging Squarely Into the Face

Big Tonnages — Less Wear — Low Costs

Look over the digging end of this shovel—its huskiness—its sturdiness — its massive strength.

The Bucyrus 100-B is the only 3-yard full revolving shovel on the market today with outside dipper handles to give you big tonnages, with the low upkeep and low operating costs.

The dipper doesn't have a chance to wobble up through the face even when digging big stuff.

The famous Bucyrus outside dipper handles deliver the full digging punch squarely behind the dipper for big loads at every pass. There is less strain on the dipper handles, the boom, and the entire shovel. That means less wear—less upkeep. Furthermore the 100-B has a box-girder type boom that is more sturdy than a split type boom of equal strength. Its large cross section area and huskiness make it look short—but the standard boom measures 29 feet 6 inches long.

The 100-B has a full 360 degree swing. Its rear end clearance is 16 feet—as a standard shovel it cleans up a level floor 54 feet wide—and dumps as high as 20 feet 6 inches.

It has single-truck, traction mounting and moves around almost as easily as a small revolving shovel.

In addition you can get the cost saving advantages of electric power. Write for the Bulletin C-311-V on this machine of big tonnages and low costs. A post card brings it.

BUCYRUS COMPANY, South Milwaukee, Wisconsin

BUCYRUS

CONTENTS of THIS ISSUE

Vol. XXXIII, No. 1, January, 1928

NOTE—For subscription terms see first Editorial page

Articles

Advertisements

Equip your valves with air-tight discs

The valves which you use for the important service of controlling compressed air can be fitted with Jenkins discs specially compounded for their service. The engineer in charge of the air lines can select from the following schedule.

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* 0 to 10 lbs. pressure Disc No. 30
*10 to 25 lbs. pressure Disc No. 15
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Jenkins Discs as well as Jenkins Valves are obtainable through supply houses everywhere.

*For Check and Spring Closing Valves Only.

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Always marked with the "Diamond"
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SINCE 1864

Leather Belting For Any Drive or Purpose

Makers of leather belting for drives of every description for over 92 years.

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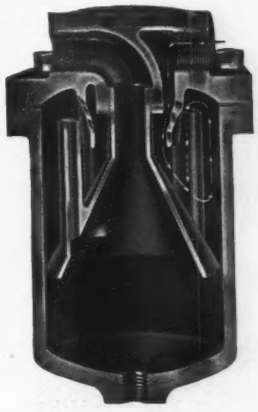
BELTING AND OTHER LEATHER PRODUCTS

Since 1835

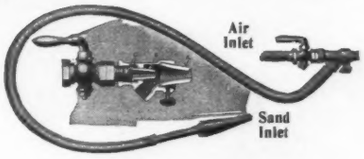
29 Murray Street, New York City

Divide Air Separators



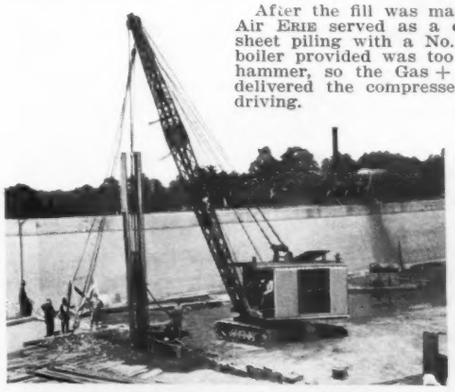
for removing oil and water from compressed air. 30 years experience in designing separators.

Cyclone Suction Sand Blast Nozzles for Cleaning Iron, Steel, Brass and Stone.



Send for Catalog

The Direct Separator Co., Inc.
Syracuse, N. Y.



After the fill was made, the Gas + Air ERIE served as a crane to drive sheet piling with a No. 2 M.-T. The boiler provided was too small for the hammer, so the Gas + Air ERIE also delivered the compressed air for pile driving.

Gas + Air Erie Working 24 Hours a Day 10 Days Continuous Running To Repair the Barge Canal

A break in the sidewall of the N. Y. State Barge Canal—flood spreading ruin. Quick action needed! W. J. Gallagher, of Medina, worked his Gas + Air ERIE three full 8-hour shifts, for 10 days continuously, without a minute's delay.

Mr. Gallagher says they loaded three 5-ton trucks in two minutes—as high as 210 truck loads in a shift. You ought to see this Gas + Air ERIE in action," writes Mr. Gallagher—"It's a wonder."

Col. F. S. Green, Supt. of Public Works, said: "This Gas + Air ERIE has given one of the finest demonstrations I have ever seen. It has moved more dirt than any other machine on the job."

ERIE STEAM SHOVEL CO., Erie, Pa., U. S. A.
Branch Offices and Representatives throughout the U. S. A.

GAS+AIR ERIE DREADNAUGHT
and Steam
Shovels, Cranes, Draglines, etc.

ERIE

Compressor Governor

For Single and Duplex Steam Actuated Compressors

Governs the speed of Compressors to maintain the slowest constant speed which will furnish any required supply and will maintain practically a constant air pressure, whatever the requirement if within the capacity of the compressor.

ERIE UNLOADER

NEW STYLE

For Single, Duplex and Multiple Stage Steam, Belt or Electric Driven Air Compressors

Maintains practically a constant air pressure, whatever the requirement. Completely unloads and loads Compressor without shock or strain.

Complete Catalog Upon Request

Jarecki

Jarecki Manufacturing Company
Erie, Penna., U. S. A.

Do You Want Dry Air?

We guarantee it!

HERE'S the little separator that does the trick. Thousands in use everywhere. Have you got yours? Guaranteed to give perfectly dry air. No wire screens to clog with oil and necessitate constant cleaning. What are you using?

Priced as follows:—

½"	$7.25	¾"	$8.50
1" and 1¼"	$11.50	1½"	$16.00
2"	$20.00		

f. o. b. factory

THE SWARTWOUT CO., *Cleveland, Ohio*
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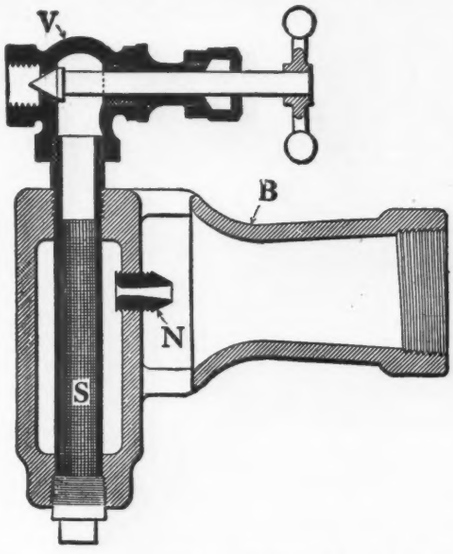
Swartwout Air Separators

Transform-Air

Transforms a small volume of Compressed Air into a large volume of low pressure air.



Forge Blower (Type F B) shown above.

Gas Furnace Blower (Type G F B) shown below overcomes low gas pressure, increases furnace capacity, induces 90% of the free air required for combustion.

Bulletin B describes fully.

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NEW JERSEY METER CO.

PLAINFIELD, NEW JERSEY

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COMPRESSED AIR PRACTICE, by Frank Richards, Associate Editor of Compressed Air Magazine.

Price, $3.00 Net, Postage Paid.

DIESEL ENGINES, MARINE-LOCOMOTIVE-STATIONARY, by David Louis Jones, Chief Machinist U. S. Navy.

A Complete Thoroughly Practical and Comprehensive Treatise Describing and Illustrating American Types of Diesel Engines, with Instructions for their Installation—Operation—Maintenance.

565 Pages, 6x9 inches, 341 Illustrations. Price $5.00.

FLOW AND MEASUREMENT OF AIR AND GASES, by Alec B. Eason, A. M. I. C. E., Associate Member of the British Institute of Electrical Engineers.

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